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THE PROPOSED HENDRICK HUDSON MEMORIAL BRIDGE TO COMMEMORATE THE TERCENTENNIAL OF THE DISCOVERY OF THE HUDSON RIVER.—[See page 366.]

SCIENTIFIC AMERICAN

ESTABLISHED 1845

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NEW YORK, SATURDAY, MAY 5, 1906.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

COURAGE AND SYMPATHY IN DISASTER.

Apart from the physical causes, the material losses, and the technical lessons of the San Francisco tragedy, of which we treated fully in our last issue, there are other considerations which, dimly perceived while the tragedy was enacting, stand out in bold relief now that distance gives them their proper proportion and significance.

For we feel that our chronicling of this stupendous event would be incomplete if we failed to pay tribute to the indomitable spirit displayed by the San Franciscans, when earthquake drove them to the hills to watch the swift obliteration of their city by consuming fire. We may search all history in vain to find a dramatic parallel to that piteous spectacle of two hundred thousand half-naked and altogether homeless people watching, in hopeless impotence, from the encircling amphitheater of the hills, the wiping off the earth of over twenty square miles of this their picturesque and passionately-loved capital city of the West!

To the extraordinary courage and self-control of the stricken citizens, and the perfect discipline of the United States regular troops, is to be attributed the fact that this enormous horde of homeless and utterly-ruined people should have come through such a terrible ordeal, without even a suggestion of those fatal panics, or wild orgies of despair, which might well have followed in the wake of such a disaster.

This is not the time for indulgence in the commonplaces of moralizing; but again we feel that our record of this event would be incomplete without a reference to that spontaneous flood of practical generosity, which instantly rolled in upon the stricken people from every State and city of the Union. Capital and labor, railroad and factory, church and theater, all have joined hands in ministration, until some twenty millions of money and unknown millions in supplies and necessities are now pouring into the devastated city.

The homeless refugees have scattered, some never to return. The majority, however, will come back to a more beautiful city, which, in its broader streets, more stable and enduring structures, the better adjustment of its municipal improvements, and above all in the unconquerable spirit of its generous and gifted people, will retain for San Francisco its well-won title of the Queen City of the Far West.

AN OPINION FROM PANAMA.

In regard to the vexed question as to whether it is advisable to build a sea-level or lock canal at Panama, it will be admitted that if, among the engineers who are now working upon the Isthmus, there is found to be a consensus of opinion in favor of one particular type, such agreement ought to be taken as very strong presumptive evidence that this particular type of canal is the best one to build. Among the voluminous testimony which has been taken before the Senate during the past few months, there is on file a letter from Chief Engineer Stevens, dated before the publication of the conclusions of the Isthmian Canal Commission, which states that the whole engineering staff seems to be unanimously in favor of the construction of a high-level lock canal. The letter says:

"Of the engineers who are now on the Isthmus in the employ of the Commission, of all ranks, of all degrees of experience and knowledge, I have yet to find a single man who is in favor of a sea-level canal. Most of them are very outspoken against such a proposition; and while it may be said that they are not men of world-wide reputation in technical knowledge and experience, I claim that an intimate knowledge of the conditions, obtained by a residence of months and years on the ground, is of far more value than any theories or conclusions, which may be drawn from existing works in other parts of the world, which bear not the slightest resemblance to the proposition at Panama."

To the engineering mind a statement of this character, coming from a Chief Engineer resident on the ground, must have a profound significance; for we doubt if there is any other profession in which the younger members take such a keen interest in, and make such a thorough study of, the larger current problems of the day in their particular sphere of work, as in that of civil engineering. Climatic and topographical conditions exercise such a controlling influence on engineering works of magnitude, that the local experience of a well-equipped man in the field, even though he be young in years and practice, may easily outweigh, for the particular problem in question, the judgment of a ripe experience which is based largely upon other conditions in far-distant and widely-scattered lands.

TRIAL SPEED AND SEA SPEED.

Among the advantages claimed for the increasingly popular passenger ships of large size and moderate speed, should be mentioned the fact that many of them are showing in regular service a rate of speed which is fully as high as that which they maintained on their trials in smooth water. Moreover, because of their great weight and momentum and their moderate speed, they are not so greatly affected by adverse weather conditions as the faster ships, and their coming and going is marked by great regularity and a close adherence to the sailing schedule. If a 23-knot ship runs into a heavy head sea, it must make a much greater reduction in its speed than is necessary in a vessel of say 15 to 17 knots speed; and, consequently, it will be more liable to miss a tide and suffer a night's detention, say at Quarantine, New York, than a ship of the slower type. As showing how the big vessels of the intermediate type are running well up to their trial speeds, we may take the case of the "Amerika," which, in a recent passage from Cherbourg to Sandy Hook of 3,140 miles, maintained an average speed of 17.31 miles an hour; while on its preceding easterly passage, it covered a distance of 3,088 miles in seven days, six hours, and twenty-four minutes, which works out as an average speed of 17.71 miles an hour. The high-speed liner, however, is not in any danger of being forced out of the field by its slower sisters; as witness the fact that the North German Lloyd have under construction a twin ship to the 23½-knot "Kaiser Wilhelm der Grosse," and that the Cunard Company will shortly put a pair of 24½ to 25-knot vessels in service. So rapid is the increase in the number of those who can afford to pay the highest rates for Atlantic travel, and so great is the demand for rapid transit on the part of those to whom time is an object, that we look to see a limited number of 25-knot vessels built from time to time for the Atlantic service. The majority of the transatlantic liners of the future, however, will undoubtedly be of the "Amerika" and the "Baltic" type; for not only are these the ships upon which the companies depend for the greater part of their revenues, but because of their steadiness, absence of vibration, and the more lengthy sea trip which they afford, they are becoming increasingly popular with the traveling public.

A RETROGRADE STEP.

It is decidedly discouraging to learn that a special board of the United States army has been the first to acknowledge defeat in the attempt which is being made by all the gun makers of the world to produce successful, high-velocity, large-caliber guns. This acknowledgment of defeat is candidly made in a recent report of the National Coast Defense Board upon the coast defenses of the United States and the insular possessions. The rock upon which the committee's hopes of producing a successful high-velocity gun have been wrecked is that ever-present trouble of "gun erosion." From the first introduction of smokeless powders, with the fierce temperatures which accompany the high powder pressures that are necessary to secure high velocity, gun erosion has been the perpetual *bête noir* of the artillerist. Do what he would to prevent it, he has been unable, so far, to find a remedy—which is little to be wondered at, when it is stated that while he is perfectly familiar with the results of gun erosion, he is still very much in the dark as to the exact way in which it does its destructive work. About all that he can tell us regarding this trouble is that the surface of the bore is gradually pitted and eaten away, the damage being most severe in the first few feet of the bore next to the powder chamber, and decreasing in severity until the muzzle of the gun is approached, when erosion begins again to be more marked. Broadly speaking, it may be said that erosion increases with the velocity; not because velocity itself induces erosion, but because high velocity can only be secured with high powder pressures, and high powder pressures mean enormously high temperatures in the gases—these temperatures being supposed to run up to something between 8,000 and 9,000 degrees at the moment of explosion.

Many explanations have been offered of this eroding action; but it is generally believed to be due to the rush of a certain amount of the gases past the shell, and this is believed to be due to ineffective sealing, or obturation, at the base of the shell. The rush of the white-hot gas between the shell and the bore is supposed to burn away the surface of the latter in much the same way as a stream of boiling water will rapidly melt away a block of ice.

The problem may be met in three ways; first, by accepting the situation, and using the guns until they become too badly eroded for accuracy, and then returning them to the shops to be relined. This is the plan adopted by the British. Another method would be to abandon high velocities and go back to the heavier projectiles and lower powder pressures of fifteen years ago; while the third alternative would be to exhaust every effort to find some better method of obturation, by which the gases could be confined at the base of the shell.

Now of these three alternatives, we regret to observe that the Board on National Coast Defense has adopted the second, and proposes to go back to the velocities that characterized our earlier weapons of the eighties. To quote the words of the report: "In developing this energy," namely, 47,299 foot-tons, due to an initial velocity of 2,550 foot-seconds in the 12-inch coast-defense gun, "the high temperature due to smokeless powder and the great increase in the volume of gas produce an erosion which materially shortens the life of the gun. There is little to warrant the hope that any material improvement will be speedily effected in the manufacture either of steel for gun construction, or in powder to overcome this erosion. . . . For these reasons the Board recommends the adoption of 14-inch guns," of 2,150 foot-seconds velocity, because "*by increasing the caliber of the gun, an equal or greater fire effect can be secured by employing a diminished velocity*," as compared with the high-velocity 12-inch gun above mentioned.

We have placed in italics the clause of the above sentence to which we feel compelled to take strong exception, for it is contrary to the theories and the decided trend of modern gun construction. The energy imparted to a projectile varies directly as its weight and as the square of its velocity. A lowering of the velocity of a projectile calls for a relatively much larger increase in its weight if the same energy is to be obtained. But the increase of the weight means an enormous increase in the weight and cost of the gun and its mount and emplacement. This is shown in the figures given in this report for the relative cost of the 12-inch high-velocity gun and of the low-velocity 14-inch gun which is proposed as a substitute. The respective costs of the 12-inch gun, its carriage, and its emplacement are $43,465, $45,000, and $100,000; for the 14-inch gun, the respective costs are $60,000, $72,000, and $150,000. One 12-inch gun, therefore, will cost $188,465, and one 14-inch gun $282,000, an excess for each low-velocity piece of $93,535. As it is proposed to emplace nineteen of these pieces, the country is called upon to expend a total of over $1,750,000 in the construction of batteries which, look at it any way we will, will mark a retrograde step in the art of gun manufacture.

Furthermore, these 14-inch guns will be distinctly inferior to the high-velocity 12-inch in accuracy; for the trajectory, or curve of flight of the projectile, will be steeper, and the danger space considerably less, particularly at the more distant ranges. A given amount of error in the estimate of distance and elevation of the gun, which would mean a miss for the 14-inch, would still involve, because of its flatter trajectory, a hit for the 12-inch piece.

It is surely a little early yet for the army to throw up the sponge in this all-important problem of gun erosion. We have long believed that it can be solved by some method of sealing the base of the shell; and we submit to the Secretary of War that if ten per cent of the $1,750,000 which it is proposed to spend were set aside for an exhaustive experimental investigation of this problem, a way would be found to obviate gun erosion, and prevent this wholesale and all-too-early capitulation.

That the radio-activity of air may be due to the escape of emanations from subterranean regions, to heat in the earth's interior causing the expulsion of negative ions from certain oxides, or to ions received from the sun, is suggested by H. Nagaoka, in a paper on radio-activity and geophysical phenomena, published in the Physico-Mathematical Soc. Tokyo Proc. The examination of the smoke from the volcanoes is proposed as a source of information which will enable us to decide the question. The possibility of terrestrial magnetism being due to the rotation of the earth, the outer crust of which is electrified by the presence of ions escaping from the interior, is pointed out. Supposing that electro-magnetic mass could be detected by a balance, it follows that those atoms whose electrons are moving the most rapidly will be the heavier, and the ratio of the atomic weights will not be the ratio of the number of electrons. Deviations from Prout's law could thus be expected.

PROF. SIR GEORGE H. DARWIN.

Prof. Sir George H. Darwin, M.A., F.R.S., LL.D., D.Sc., the English scientist at present in this country for the purpose of attending the Franklin bicentenary celebration at Philadelphia, is the second son of Charles Darwin, the great naturalist. The Darwin family for generations has included men distinguished in the arts and sciences; and while the originator of the Darwinian theory, one of the most eminent investigators and thinkers England has ever produced, unquestionably overshadows the others, it has not been through his reflected glory that his sons have taken their deservedly prominent position in the world of science. Sir George H. Darwin was born at Down, in Kent, England, in 1845. He was educated under the Rev. Charles Pritchard, who subsequently became a Fellow of the Royal Society, and the Savilian Professor of Astronomy at Oxford. In 1864 George Darwin entered Trinity College, Cambridge, from which he was graduated in 1868 as Second Wrangler and Smith's Prizeman. From 1868 to 1878 he was a Fellow of Trinity College, and was re-elected in 1884. He studied law, and was admitted to the bar in 1874, but he did not subsequently practise that profession.

In the following year he returned to Cambridge, and devoted his entire time to the study of the mathematical and astronomical sciences, and particularly to experimental investigations on the pressure of loose sands, on changes in the level of the earth's surfaces, and on minor earthquakes. His interest in astronomical and meteorological studies and investigations had been aroused prior to this, and in 1870-71 he accompanied the English expedition to Sicily to observe the eclipse which occurred during that period. In 1882 Prof. Darwin assisted Sir William Thomson (Lord Kelvin) in the preparation of a new edition of Thomson's and Tait's "Natural Philosophy," and in the following year was appointed Plumian professor of astronomy and experimental philosophy at Cambridge, succeeding the Rev. James Challis, M.A., F.R.S., to a chair which Prof. Darwin still holds with distinguished success. From 1885 to 1905 he was a member of the Council of the Meteorological Office of Great Britain, and he served on the Meteorological Committee of 1905. He was chosen a member and later, in 1879, a Fellow of the Royal Society. Last year he was elected president of the British Association for the Advancement of Science, and as the head of that association, he formally opened the Victoria Falls Bridge over the Zambesi gorge in central Africa in September of last year. In 1885 he received "a royal medal" from the society for his scientific work, and also one from the Royal Astronomical Society.

Prof Darwin is an honorary graduate of the universities of Glasgow, Dublin, and Padua, as well as a member of several British and foreign academies of science.

Prof. Darwin's published contributions to scientific literature include papers on consanguineous marriages, for the Statistical Society; jointly with his brother on Small Deflections of the Plumb Line Due to Movement of the Earth, British Association Report; a series of reports to the British Association on Harmonic Analysis of Tidal Observations, 1883 and later; several papers on the same subject in the Proceedings of the Royal Society; a series of memoirs on the Effects of Tidal Friction on the Earth and on the Moon, Philosophical Transactions of the Royal Society; papers on subjects cognate to the last, and on Figures of Equilibrium of Rotating Masses of Fluid and on the Mechanical Constitution of a Swarm of Meteorites, Philosophical Transactions of the Royal Society; a paper on Periodic Orbits, in 1896; and one on the Tides and Kindred Phenomena in the Solar System, 1898.

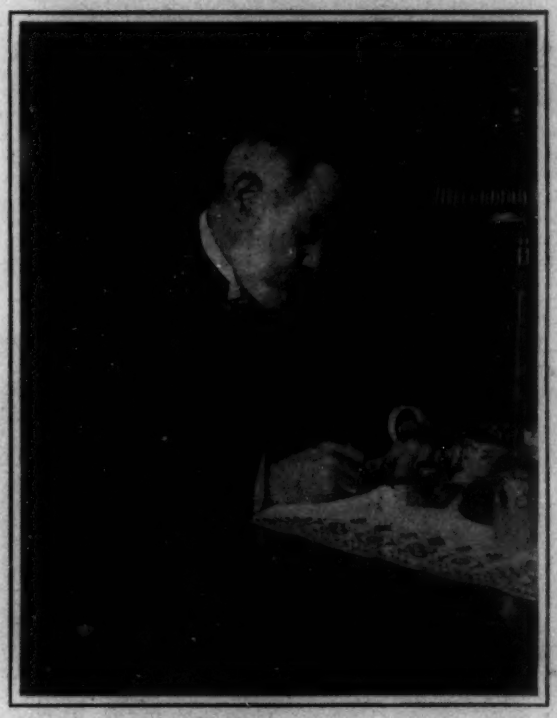
THE PROPOSED AMENDMENT TO THE TRADE-MARK LAW.

A bill has been introduced in the House which has for its purpose the amendment of the trade-mark law of 1905.

One section of the bill authorizes the Commissioner of Patents to establish classes of merchandise for the purpose of trade-mark registration. A trade mark may be registered at the option of the applicant for any or all goods upon which the mark has been actually used. This will enable both attorneys and applicant to know the scope of their trade-mark protection. Up to the present time the Patent Office has registered under one application only goods of the same descriptive properties. By providing for the classification of trade marks, American practice will be brought into accord with the trade-mark practice of other countries so far as classification is concerned. If the bill becomes a law, this provision alone will have a most salutary effect. In foreign countries American marks are registered only for the class of goods covered by the domestic registration. Hence, a large dry-goods house which uses one mark on perhaps several hundred kinds of goods, and which under the existing law is compelled to file a United States trade-mark application for each article of merchandise, is required to file exactly the same number of applications abroad, thereby incurring a considerable expense. By the provisions of the present bill all this will be obviated. One class will be covered in America, and one class in each of the foreign countries in which the trade mark is to be protected.

Still another section of the amendment provides that any owner of a trade mark who has a factory within the United States shall be afforded the same protection for marks used on the products of his factory as though he were domiciled within the United States. Some foreign houses have established manufacturing plants in this country, and manufacture goods which are not marked in the same manner as those made in their native countries. The foreigner cannot register such a mark first at home and then re-register it here. It is to protect these foreign manufacturers that the provision in question has been inserted in the bill.

One other amendment deserves attention. It provides that "a description of the trade mark only when needed to express colors not shown in the drawing" need be filed. Inasmuch as almost every trade mark is more or less colored, the preparation of a detailed description of the mark has been a matter of considerable difficulty. Sometimes the registrant received more than he was entitled to; sometimes he was too narrowly limited. The amendment is intended to cure the evil. Whether the bill will become a law or not, remains to be seen.



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SIR GEORGE H. DARWIN.

THE WHISTLING VIBRATION OF A DROP.

In experiments carried on by T. Terada and set forth in an article entitled "Whistling Vibration of a Drop," which was published in the Physico-Mathematical Soc., Tokyo, Proc., a capillary end is fused in a glass tube 5 millimeters in internal diameter, and the other end is connected to an air-bag of considerable capacity, which is pressed by a constant weight.

On wetting the nozzle with some liquid, such as water or olive oil, and then blowing through the liquid, a musical note of definite pitch is produced, the latter depending upon the dimensions of the nozzle, as well as the quantity and nature of the liquid. A microscopic examination shows that the liquid bubble is wide open while the note is sounding, and that the note is due to the vibration of the edges of the liquid. The pitch varies nearly inversely as the radius of the aperture, and inversely as the square root of the density of the liquid. It varies directly as the square root of the capillary constant. When the liquid is magnetic, like a solution of ferric chloride, the establishment of a magnetic field about it immediately lowers the pitch in some cases, and raises it in others. This phenomenon may be useful for demonstrating the magnetism of liquids, or for exploring magnetic fields otherwise inaccessible.

Motor car statistics for 1905 show that 27,840 machines were built in America. Of this number 22,970 were sold.

THE NATIONAL ACADEMY OF SCIENCES.

BY MARCUS BENJAMIN, PH.D.

The National Academy of Sciences held its stated session in Washington city on April 16, 17, and 18, meeting as usual in the National Museum, with Dr. Alexander Agassiz, the president of the Academy, in the chair. The meeting this year was convened a day earlier, so that on the adjournment of the Academy the members might participate in the anniversary exercises commemorative of the bicentenary of Benjamin Franklin, celebrated later in the week under the auspices of the American Philosophical Society in Philadelphia, Pa.

There were sixteen papers presented at the public sessions. Of these the first was "Recent Developments of Existential Graphs and Their Consequences for Logic," by Charles S. Peirce, and was a special presentation of a method of logic of his own devising. Prof. J. M. Crafts gave a paper on "Primary Standards for Temperature Measurements Between 100 deg. and 350 deg.," which was a report of progress in continuation of the work that he has so successfully carried on during recent years. Of more popular interest was a paper entitled "Interference of Oviposition of a Sargasso Fish with a Flying Fish," by Theodore Gill. It appears that ever since 1872 the Sargasso fish has been famous as the builder of a remarkable globular nest made of the Sargasso weed, in the midst of which it makes its home. This fact was assumed by the elder Agassiz in consequence of the nest being used by the fish mentioned, and has continued ever since to be accepted by writers on ichthyology. During the last winter some eggs of the Sargasso fish were obtained by the Fish Commission and examined by Dr. Gill, who at once came to the conclusion that such nests could not be made by the Sargasso fish. It is well known that eggs of certain flying fish possess filaments that could readily become entangled with the floating seaweed, and consequently build such nests. The arguments in favor of this theory were skillfully presented by Dr. Gill. A highly technical paper on "Commelinaceæ. Morphological and Anatomical Studies of the Vegetative Organs of Some North and Central American Species," by Theodore Holm, a non-member of the Academy, was presented through the interest of Dr. Gill.

The second day's programme began with the presentation of "The Distribution of American Men of Science," by J. McKeen Cattell. It will be recollected that Prof. Cattell has recently published his book on "American Men of Science," in which he stars the thousand leading men in their leading specialties. In the printed table which he distributed there were five tables showing (1) the birthplaces and residences according to States, (2) the residences in cities, (3) the distribution according to colleges and other institutions, (4) the attendance at various educational institutions, and (5) the branches of sciences in which the men considered pursued graduate studies. These facts he presented.

Major Clarence E. Dutton, with the title "Radio-Activity and Volcanoes," showed that the origin of the former could be traced to the latter. This paper, although technical, on account of the timeliness of the subject attracted much attention.

Prof. Henry F. Osborn read a paper written by W. J. Sinclair, a non-member of the Academy, entitled "Volcanic Ash in the Bridger Beds of Wyoming," in which the announcement of the finding of extensive quantities of volcanic dust in the Bridger beds in southwestern Wyoming was made. This was interpreted as explaining the peculiar formation of these deposits, which had been previously supposed to be due to erosion. The presence of volcanic dust would explain in a reasonable way the lack of certain forms of life, and also show that a shorter period of time covered their formation. Over the title of "Faunal and Geologic Succession in Eocene and Oligocene Basins of Rocky Mountain Region," Prof. Osborn showed that the various expeditions sent out by the American Museum of Natural History had located very complete series of strata showing the entire Eocene formation, so that from the study of these, full information as to the life prevalent at that time and other facts would be available. This was very gratifying, as nowhere else was so perfect a series of strata of that period to be had.

Director Charles D. Walcott gave an account of the "Cambrian Faunas of China," with lantern illustrations. He told of the expedition sent out under the auspices of the Carnegie Institution to study certain geological horizons in China, and that as a result information has been obtained showing that a better series of Cambrian strata could be found there than elsewhere. Then passing to the discussion of the brachiopoda from there, he pointed out the new forms, and also indicated many specimens of which similar

(*Continued on page 366.*)

THE AUTOMATIC CONVEYER IN LUMBERING.

BY DAY ALLEN WILLEY.

The development of mechanical processes in connection with lumbering and other industries in which wood in its various forms constitutes the raw material, has reached such a point that power conveying machinery is being utilized in a remarkable variety of ways. To a certain extent it has taken the place of hand labor and other machines in getting logs out of booms and transporting them to the mill; it takes away the planks and beams into which they are sawed as fast as the material is cut, while at the same time another form of the apparatus removes the chips and waste material. The employment of a system which performs this labor enables the modern sawmill of large capacity to be operated with a very small number of hands, compared with the days when human labor was required to such an extent to handle the material in its various stages.

A form of log conveyer has been perfected and is in service which is notable for its capacity. It can be constructed to operate over distances ranging from 50 to 500 feet, and has been utilized in transporting logs up to a length of 50 feet each. The accompanying illustration shows a conveyer of the Jeffrey system, in which steel chain is employed provided with spurs, which are attached to the lengths at convenient intervals. The chain travels between wooden guides, and can be moved at a speed ranging from 50 to 100 feet per minute according to the horse-power employed. This averages about 5 horse-power to 100 feet with the conveyer fully loaded. It will carry four logs ranging from 20 to 25 feet in length to every hundred feet if desired. In the illustration the logs are taken from a dam, being guided by hooks to the water end of the chain. Thence they are conveyed automatically to the mill, which is not shown in the picture. The chip conveyers are constructed in various forms according to the service required. As the loads they are intended to carry are much lighter than the log haulers, they can be operated at a greater speed, running at a rate varying from 150 to 350 feet per minute. If the mill is a large one and the quantity of waste considerable, high-speed conveyers are usually preferred. In one type the roller chain is employed. It is divided into sections of about three feet each, and runs in a trough of boards. The waste material is dumped onto the conveyer just as it comes from the mill. Chips, splinters, and even sticks five and six feet long as well as sawdust are thrown into it, but the arrangement is such that it removes the material without clogging. In some cases the discharging end of the conveyer is carried over bins, into which the contents fall by force of gravity. It can also be dumped into vehicles automatically and removed if desired. In another form of chip conveyers, endless belts are used, which travel in a covered way. This apparatus is notable for the service it can perform under varying conditions. The illustration shows a conveyer at the works of the Oxford Pulp and Paper Company. It carries chips a distance of 1,000 feet between the upper portion of the plant and the ground.

A 1,500-Foot Conveyer Used in Connection with a Pulp Plant.

The modern pulp mill requires such a large amount of raw material, that in connection with it an extensive storage yard is usually arranged. The necessity of some system which will furnish an adequate supply to the machinery is imperative; but as the wood comes in various forms ranging from logs over two feet in diameter to pieces of but a few inches in thickness, any conveying machinery employed must be arranged to accommodate itself to the different dimensions. The conveyer which is depicted is installed for handling pulp wood in lengths ranging from two to four feet, and carries the material either at an angle or on the level. Utilized for piling the wood in the storage yard, it automatically unloads itself. The trough of timbers through which it moves is divided into sections, some of which can be removed. As fast as the logs reach an open section, they drop from the trough to the pile beneath. The conveyer illustrated

Type of Heavy Conveyer for Hauling Logs to Sawmill.

Carrying Away Sawmill Waste by Chain Conveyer.

Endless Conveyer for Carrying Wood.

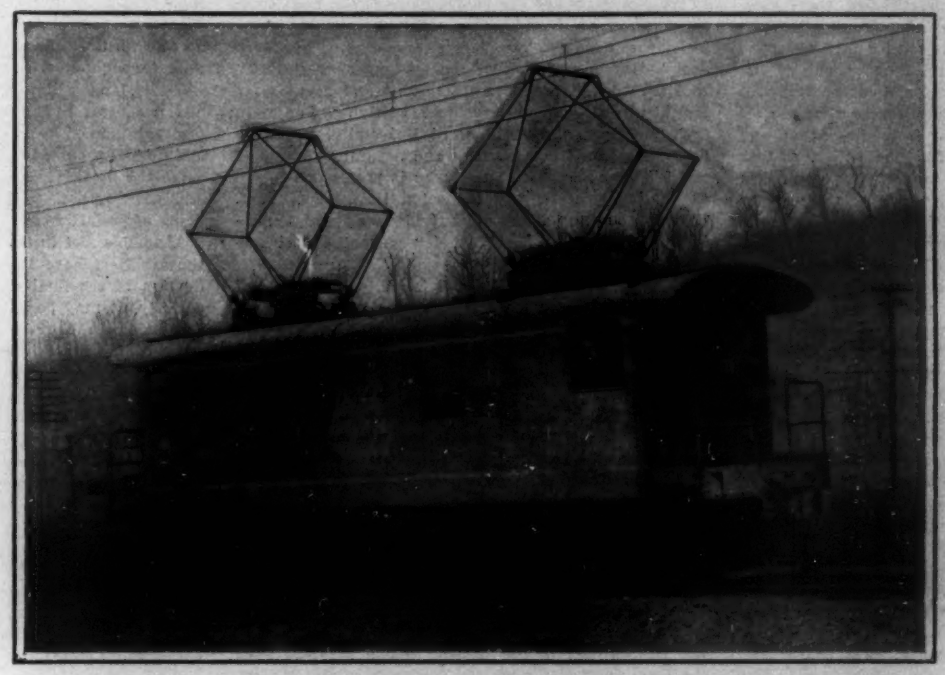
Conveyer for Hauling and Storing Pulp Wood.

THE AUTOMATIC CONVEYER IN LUMBERING.

has a length of about 1,500 feet, and can handle from 300 to 600 cords daily. The horse-power required averages from two to three in every hundred feet when the conveyer is traveling at this rate per minute. In one installation of this sort the pulp wood is loaded upon the conveyor from railroad cars, carried to the storage yard, and dumped. At the storage yard the conveyer is depressed to the surface of the ground, and this section is used to supply the mill from the storage yard.

The accompanying photograph shows one of the largest storage yards, which is served by two conveyers, owing to the large quantity of material which is handled. One of these is composed of jointed rods, but like the other referred to it is endless, passing around wheels at each terminal.

Practically all of the conveying machinery used in connection with sawmills, pulp factories, and other woodworking establishments is operated by steam power for convenience, the wheels upon which the endless chains or belts move being belted to shafting or to the flywheel of a special engine. To operate the largest size rarely more than 50 horse-power is needed, and the steam can be furnished from the boiler plant operating the other equipment.



AN ELECTRIC LOCOMOTIVE OF THE NEW YORK, NEW HAVEN AND HARTFORD RAILROAD.

THE ELECTRIC LOCOMOTIVES OF NEW YORK, NEW HAVEN AND HARTFORD RAILROAD.

Great interest attaches to the new electric locomotives now building for the New York, New Haven, and Hartford Railroad, because of the unusual conditions they are required to meet. An overhead alternating-current trolley system is to be installed on the line from Stamford to Woodlawn. At the latter station the road joins the Harlem branch of the New York Central Railroad, which is to be equipped with a third-rail direct-current system. The locomotives must thus be adapted to operate with both direct and alternating current. The alternating-current line will be fed from a single power station at Riverside, three miles from Stamford and nineteen miles from Woodlawn. Three turbine-driven generators will be used, which are so wound that they will supply either single-phase or three-phase current, and each has a rating of 3,750 kilowatts single-phase, or 5,500 kilowatts three-phase. Current will be supplied to the trolley system under a tension of 11,000 volts; hence no transforming stations will be necessary along the line. Each locomotive, however, will be provided with a pair of transformers to step-down the current to a working pressure. The purpose of having two transformers is to distribute the weight in the locomotive, and also to provide against total disablement of the locomotive in case of injury to one of the transformers. Current will be collected by means of a pair of pantograph-type, bow trolleys. Eight collecting shoes are also provided for the third-rail system, four of the shoes being designed to run under the power rail and the others on the top of the rail, thus allowing for conditions on the New York Central portion of the road. A pair of each type of shoes is mounted at each end of the locomotive.

The motors, of which there are four, each have a nominal rating of 250 horse-power, and a continuous capacity of over 200 horse-power, comprising a total of more than 800 horse-power to each locomotive. They are adapted to operate with a voltage of about 235 on alternating current, and from 275 to 300 on direct current. The motors are of the compensating gearless type, and contain some very novel and interesting mechanical features. They are suspended from frames, which fit over the trucks and rest on the journal boxes. Depending from each frame are four bolts provided at their lower ends with coil springs, on which the motor is supported. The armature is not directly connected to the axle of the truck, but is mounted on a quill which passes over the axle, with an all-round clearance of ⅝ inch. On this quill the bearings of the fields are mounted. The quill is formed with a wide flange at each end, and projecting from the face of each flange are a series of pins adapted respectively to engage a series of pockets in the hub of the wheel. Around each pin is a coil spring with its coils progressively eccentric, and these bearing against the sides of the pockets serve to transmit the motive power to the wheels. To prevent wear, steel bushings are fitted over the pins and into the pockets, and between these the eccentric springs operate. This construction provides for a certain amount of vertical and lateral movement, while the motor is centered axially by the compression of the springs between the end walls of the pockets and the flange of the quill. Strong coil springs are fitted into the ends of the pins, and bear against the end walls of the pockets to take up the end play of the motor. In order to prevent the motors from pressing against the wheels when thrown by centrifugal force at curves, they are adapted to bear against rails on the truck frames. This construction has proved an excellent one. The entire locomotive is spring-supported with the exception of the driving wheels, axles, and journal boxes.

A novel feature of the new locomotive is the system of ventilating the motors. In this system the channel beams used in the framework of the car are utilized to provide conduits through which air is pumped by means of a fan in the cab to the motors and transformers. As this air is taken from within the cab, it is fairly dry and clean. The air current, aside from carrying off the heat generated by resistances, also serves to keep the motor free from dust. The locomotives measure 36 feet 4 inches over all, and have a weight of about 85 tons. Tests of one of these locomotives have proved very favorable. A 250-ton train can be handled on a through service with a speed of 60 miles per hour, while heavier trains will be hauled by two or more locomotives coupled together and operated in multiple. In local service a 200-ton train can be operated at an average speed of 26 miles per hour with stops about two miles apart, and making a maximum speed of about 45 miles an hour. The frame, trucks and cab of the locomotive were constructed by the Baldwin Locomotive Company, and the electrical equipment is being installed by the Westinghouse Electric and Manufacturing Company.

A novel use of compressed air is made by some railway companies in the Southern States of America, says the Railway News. When the loads of cotton for export are being taken to the coast, there is always some danger of such highly inflammable material becoming damaged through sparks from the locomotives. To prevent this, the locomotive boilers are filled with compressed air. A train load of several thousand bales of cotton can be hauled by these locomotives at a rate of twelve miles an hour, although no fire whatever is used in working them.

A NEW METHOD OF HEATING SWITCHES.

The greatest difficulty that railroads have to contend with in winter time is the blocking of switches with snow and ice. While it is a comparatively easy matter to clear the main line of a heavy fall of snow, in the yards even a moderate fall of snow is apt to demoralize the schedule. If the storm is a dry one, the difficulty is confined to shoveling away the snow at the switches. This in itself is no small task in a busy yard, crowded with a maze of converging and crossing lines; but when the snow is wet and then freezes, the difficulty is increased many fold, and serves sometimes to completely tie up and demoralize the system. To overcome these serious conditions, various suggestions have been put forth. Attempts at heating the switches electrically have proved very expensive and quite dangerous, owing to the possibility of short circuits in the network of rails. Steam-heated switches have also met with but little success,

THE OIL HEATED SWITCH AFTER A SNOWSTORM.

METHOD OF LAYING THE PIPES FOR THE OIL-HEATED SWITCH.

due to the danger of condensation, and subsequent freezing, which would entirely block the steam pipes. A new system has recently been developed by Mr. Frank L. Young, of Boston, Mass., which is calculated to overcome the above-mentioned objections. In place of steam, heated oil of a special quality is circulated through pipes placed between the ties. The advantage

of oil over steam is that it retains its heat better, and will not chill at 20 to 25 deg. Fah. below zero. Furthermore, if it should chill, it will not expand and burst the pipes as water would when freezing. Steam must be delivered to the pipes at a high temperature, while oil can be circulated without pressure at any degree between 20 deg. below and 400 deg. above zero, and furthermore, the plant can remain idle in very cold weather when it is not required for melting snow. A test of this system was carried on at one of the switches in the yard of the Boston & Maine Railroad at Boston last winter. The plant for heating the oil was located about 350 feet away from the switch, and consisted of a 3-horse-power fire-tube boiler, a gear driver, a screw pump, and a tank. The heater and tank contained the special oil, which was carried to the switch in an underground line of pipe. The oil was forced through the pipes by the pump at any desired temperature, and returned again to be reheated. At no time was it found necessary to heat the oil above 270 deg. At the switch a number of covers or boxes were placed over the pipes, so as to retain the heat and keep the ground in the vicinity in a normal summer condition. The great value of this was that in time of a snowstorm the melted snow would drain off into the ground just as it would during a summer shower, as the ground would be kept from freezing by the heat of the pipes. The past winter furnished no very severe storms which could show the value of this system under extreme conditions. However, on March 15 last, a snow storm occurred which continued all day and a part of the night. From seven to nine inches of snow fell. A wind of between 30 and 40 miles an hour drifted the snow to a depth of two feet or more in many places. The accompanying photograph shows the condition of the switch immediately after this storm. It will be observed that not a particle of snow remained about the switch except in a few places on the ties, which are insulators of heat, nor was there any collection of water to freeze afterward and cause trouble, because the moisture was all drained away into the dry ground. On the average eight inches of snow is equivalent to one inch of rain. Hence it will be evident that even a very heavy fall of snow would be melted and drained off without any serious difficulty.

THE NATIONAL ACADEMY OF SCIENCES.

(*Continued from page* 363.)

forms had been found in this country. The final paper was on "Recent Solar Investigations," by George E. Hale, who showed with lantern slides the installation of the observatory erected on Mount Wilson in California, and dwelt especially on certain forms of apparatus specially desired for the study of the composition of the sun. In the domain of astro-physics Dr. Hale stands foremost in this country, and exceptional opportunities have been afforded him by grants from the funds of the Carnegie Institution.

On Wednesday the final session of the Academy was devoted to the consideration of a paper on "Some Recent Solar Eclipse Results," by W. W. Campbell and C. D. Perrine, of the Lick Observatory, and was a preliminary presentation of a number of photographs taken during recent eclipses by the authors. The peculiar features of the corona were the subject of their special consideration, but no final decisions were attempted. Prof. M. I. Pupin discussed his work on "Feeble, Rapidly Alternating Magnetization of Iron," and described the difficulties encountered and overcome in the securing of an iron suitable for his special researches. Essentially, he found that the mechanical treatment of an iron had much more to do with accomplishing this result than its chemical composition. By what might be called a slow process of annealing, he believed that the molecules of iron arranged themselves so as to be most satisfactory in yielding a permanent kind of iron.

A paper entitled "The Life History of Pterophryne," by Theodore Gill, was presented by title, and in the absence of the authors, biographical memoirs of Admiral John Rodgers by Asaph Hall and of George P. Marsh by William M. Davis were also presented by title only.

The final paper of the session was "On the Classification of the Cidaridæ," by Alexander Agassiz and H. L. Clark, and was presented by the senior author. He first called attention to the fact that the Cidaridæ represented a variety of sea urchins that had persisted since the Jurassic period, and said that numerous authors had attempted to make a classification of this family, but the results had not been satisfactory. Too much stress had been laid upon special features, such as the spines, which subsequently were found to vary in individuals, thus vitiating the classification. Finally, Mr. Clark had made a complete investigation of the family, and from a study of all of their characters had prepared a classification that was applicable to both the fossil and living members of the family.

The biennial conferment of the Henry Draper gold medal for distinct contributions to astronomical science was this year made to William W. Campbell, director of the Lick Observatory in California. As Dr. Campbell was present at the meeting, the actual presentation was made at the dinner given on Tuesday night by President Agassiz.

Only four persons may be elected during one year to the Academy, and the names undergo the most careful scrutiny even before they reach the electing body. This year three new members were chosen. They were Josiah Royce, professor of the History of Philosophy in Harvard University in Cambridge and famous for his historical and philosophical writings; Benjamin Osgood Peirce, also of Harvard University, where he fills the chair of mathematics and natural philosophy; and William Berryman Scott, who is professor of geology and paleontology in Princeton University. Prof. Scott has long been known as the leader of the Princeton expeditions to the West for paleontological material.

In addition, Prof. Wilhelm Ostwald, of Leipzig, and Prof. H. A. Lorentz, of Leyden, were elected as foreign associates.

The Academy will hold its autumnal meeting in Boston, Mass., beginning on November 20 next.

THE HENDRICK HUDSON MEMORIAL BRIDGE.

In a little over three years from the present date, New York city proposes to celebrate the tercentennial of the discovery of the Hudson River, by the formal opening of the truly magnificent memorial bridge which forms the subject of our front-page engraving. That the event will have the enthusiastic co-operation of the State through which the Hudson River runs, is certain, while national interest will be as broad as the Union itself in an event which cannot fail to awaken interest throughout the whole world. It is not our purpose in the present article to dwell upon the facts connected with the discovery of the Hudson by the intrepid English navigator. It is enough to state that although he was English by birth, it was from the Dutch that he received the recognition and financial assistance which enabled him to set sail in the little "Half Moon." It was natural that, after the scant encouragement which he had received in his native land he should signalize his appreciation of his royal welcome by the change of his name from Henry to Hendrick. This, according to the best authorities, is the name under which he sailed, and by which the centennial memorial should be known.

The voyage which resulted in the discovery of the Hudson was begun in the early spring of 1609, under the direct orders of the Dutch East India Company. Hudson made land in latitude 44 degrees north, and then sailed south until he discovered the noble river which bears his name. For fifty leagues the adventurous navigators of the "Half Moon" pushed their way up the river, crossing its broad bays, stemming the swift currents where the stately mountains converge in the highlands to narrow its channel, and finding the country "a land as pleasant with grass and flowers and goodly trees as any they had seen."

From a study of the perspective drawing on the front page of this issue, an excellent idea may be gained of the great proportions and architectural and engineering beauty of the proposed memorial bridge. It will span the Harlem River at the point where it connects with the Hudson, and it must be acknowledged that, in view of the topographical and scenic features of the site, no better one could have been found within the limits of Greater New York. Apart from its intrinsic worth as a memorial structure, this lofty viaduct will form an important and greatly-needed link in the parks and driveways, which at present lie scattered over Greater New York, in a somewhat disjointed and unrelated way, and with no adequate means of communication from one to the other. The bridge will have particular value as forming an important extension of the Riverside Drive which reaches from Seventy-second Street, by way of the steel viaduct across Manhattan Valley and the Lafayette Boulevard, to the picturesque heights of Inwood. Here the viaduct will carry the driveway, at an elevation of about 170 feet above the water, to the opposite heights above Spuyten Duyvil, where the automobilist and the driver will find themselves in touch with the fine system of roads which extends up the easterly bank of the Hudson and radiates through picturesque Westchester County.

As a preface to our description of the memorial bridge, we wish to emphasize the fact of its monumental proportions, which are on such a scale as to render it by far the most important memorial structure of its kind ever planned. From abutment to abutment it will have an extreme length of a little under half a mile, or to be exact, 2,500 feet. It will consist of a central steel arch, measuring 825 feet from center to center of end pins, and two massive masonry approaches consisting on each side of a series of arches of from 65 to 90 feet span. The center steel span will be the largest but one in the world, being only 15 feet less in length than the celebrated steel-arch bridge over the Niagara gorge. As herewith shown, the center span is carried on four great trussed arches of the three-hinged type, although if the larger appropriations asked for be granted, it is probable that among other improvements that will be rendered possible, will be the substitution of two-hinged arches for the three-hinged, as here shown—a change which will insure more perfect harmony of the steel span with the architectural features of the whole design. The viaduct throughout will have a width over parapets of 100 feet, and will provide for two 18-foot sidewalks, and a central 60-foot roadway. The main abutments are each pierced by two colossal arches of 65 feet span and no less than 120 feet clear interior height. Beyond these the northerly approach is carried on five arches and the southerly approach on two, the latter each being of 90 feet span.

A notable fact in the design is that the engineer and the architect have thoroughly co-operated in the production of the final plans. Too often, in fact almost entirely, it may be said, there has been no such collaboration in the design of municipal bridges, and some of the most important structures in New York city have suffered greatly in this respect. The architectural treatment is what might be called the modern classical. No attempt has been made at elaborate adornment, the colossal scale of the work rendering such adornment unnecessary and futile. The decorative features have been confined almost entirely to details of a kind that can be seen and appreciated from the driveway itself.

The strictly memorial character of the bridge will be greatly assisted by the fact that at the approach to the viaduct on the Inwood side and in line with the axis of the bridge, there is a natural hill or knoll similar to that on which Claremont is situated at the corresponding entrance to the Riverside viaduct, which will be utilized for the erection of a Hudson memorial. The knoll is about 35 feet in height and the roadway will swing around it on the east and west and meet in the plaza which forms the entrance to the viaduct. This memorial will take the form, probably, of a massive pedestal surmounted by a statue of Hudson, or possibly a model of the historic craft in which he sailed. This feature, however, is not included in the plans which are covered by the present and requested appropriation, but will probably be carried through by popular subscription.

As the tercentennial takes place in a little over three years from the present date, it is evident that a start on the construction of the bridge should be made at once. The city has already appropriated $1,000,000, and a committee of the Board of Estimate, including the Comptroller, and the Presidents of the Boroughs of the Bronx and Manhattan, has recommended that a further appropriation of $2,000,000 be made, thus bringing the total appropriation for the whole structure up to $3,000,000. The proposal has the hearty indorsement of the Mayor, and it is probable that it will be carried through at an early date.

The Current Supplement.

An article on single-phase locomotives and motor cars in Bavaria and Sweden, by Frank C. Perkins, opens the current SUPPLEMENT, No. 1583. Of technological importance is an article by Felix Lindenberg on the uses of natural asphalt in the arts. Valuable formulæ are given. Mr. James P. Maginnis's third installment on Reservoir, Fountain, and Stylographic Pens is published. The selection of Portland cement for concrete blocks is discussed by Richard K. Meade. Alexander G. McAdie presents the third installment of his treatise on lighting and the electricity of the air. To the man who likes to experiment at home and learn something for himself of the elementary laws of physics, an article on experiments with a lamp chimney will be welcome. Other articles of interest are those on the Renovation of Worn-out Soils, the Mystery of Man's Capacity to Answer a Simple Question, Liquid Crystals, and Heat Insulation.

Self-Igniting Mantle.

Platinum sponge becomes incandescent on contact with gas and causes its ignition. This phenomenon has given rise to various arrangements for producing the flame direct. MM. Rouxeville and Michaud have patented in France a process in which the addition of any foreign apparatus to the mantle is avoided. They have recourse simply to a mixture in which platinum sponge is the essential ingredient, composed of refractory and adhering substances. Impregnated with this mixture in its upper texture, the mantle has the power of igniting the gas, and of thus becoming incandescent. The stem may also be covered with the composition, and the same result secured.

A statue of Mathias Baldwin, founder of the Baldwin Locomotive Works, has recently been presented to the city of Philadelphia by the officials of the works, and will be placed in Fairmount Park.

Correspondence.

The Behring Sea Tunnel.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of April 7 I read with much interest the article "Tunneling Behring Sea." I was over the ground in 1900, and think you are safe in saying that a tunnel is not the proper way to make the connection between Alaska and Siberia. But there is no reason why a ferry could not be run across Behring Strait.

It would have to be a special type of double propeller boat. The Eskimos go across the strait in their skin boats. The heaviest ice that is ever in Behring Sea is that which goes down the Yukon River in the spring. There is a current in Behring Sea that sets north, and takes all the ice into the Arctic. There is no reason why a large car ferry could not make regular trips. J. H. WOOD.

Stony Ford, N. Y., April 9, 1906.

[Some interesting details concerning the engineering difficulties that would have to be encountered in the construction of a railroad connecting Russian Siberia with Alaska *via* the Behring Strait is afforded by Mr. Harry de Windt, the well-known explorer, who is thoroughly conversant with the country through which the contemplated railroad would be built, as he passed through this region on his memorable overland journey from New York to Paris in 1901.

He states that it would be necessary to lay down over 3,000 miles of track. The chief obstacle is the Siberian "tundra," which a train would have to cross before reaching the Strait. Tundra is a native word signifying the vast expanse of swamp and marshland, interspersed with numberless stagnant lakes, which extends for thousands of miles across the Arctic zone in Siberia. In summer time the tundra is like a wet sponge, into which even a man sinks knee deep at every step, and consequently the natives seldom venture any distance from home save by lake or river. From May to October settlements are completely isolated by this vast ocean of swamp. It is only in winter, when the tundra has been covered with a layer of hard-frozen snow many feet in depth, that these people are able to move from one place to another in a dog or reindeer sled.

The tundra section of the line he estimates would cost about one hundred million dollars, for every wooden cross-tie would have to be imported into this treeless country. There is a general impression that, although the winter would probably impede the traffic, trains could easily run up to the Behring Strait during the summer, whereas this is the very season when the line would be rendered absolutely useless by floods and the yielding of the swampy treacherous tundra. As to the winter, during his three months' trip from Yakutsk to Behring Strait in dog and deer sleds, furious blizzards frequently piled up snow drifts twenty feet high and a couple of miles in extent in the course of a few hours.—ED.]

Stellar Universe in Miniature.

To the Editor of the SCIENTIFIC AMERICAN:

Having recently taken up the study of astronomy, I am much interested in the articles on that subject which from time to time appear in the SCIENTIFIC AMERICAN. Nothing perhaps is more difficult to the beginner than to form a just and adequate conception of the vast scale on which the stellar universe is constructed; and with a view to a diminution of this difficulty, I would like to suggest an imaginary illustration which I have found very helpful to that end.

Let us suppose a miniature representation of the heavens on a scale of one hundred millions of miles to the inch. On such a scale our sun would be represented by an incandescent particle, or minute globe (about one-hundredth of an inch only in diameter, but radiating its light and heat to a great distance around), the earth (a mere speck) would be located at a distance of about one inch from the sun, Mars at 1½ inches, Jupiter at 5, Saturn at 9, Uranus at 18, and Neptune at 28 inches. Now, in regard to the "fixed" stars, it is a somewhat remarkable coincidence that light (speeding at 192,000 miles a second) traverses in one year a distance which corresponds approximately to one mile on the above scale of one hundred millions of miles to the inch; therefore, Alpha Centauri (the nearest of the "fixed" stars), whose light takes about three and a half years to reach the earth, would be represented in our imaginary sphere by another incandescent particle—or rather (being double) by two such particles—at a distance of about three and a half miles from our own sun, with its attendant planets, and, in like manner, all of the other "fixed" stars would be placed at distances approximating in miles to the same number of years that it takes for their light to reach the earth, based on the determination of their parallax: thus Sirius would be distant about 15 miles, Vega 22 miles, Arcturus 28 miles, Polaris 45 miles, Capella 70 miles, and so on, in various directions. It will thus be seen that in order to represent, on this very diminutive scale, the starry sphere (of which our own solar system forms so minute, but not "insignificant," a part) it is necessary to imagine a sphere of many hundreds of miles in linear dimensions—to say nothing of stellar systems which perhaps lie entirely outside of our own, and which, even in our best telescopes, are lost in the depths of space.

If it be objected that this imaginary illustration impresses one most with a sense of the comparative vacuity of space, it may be observed that space is nothing to a Creator who is invested with the attribute of Infinity; and it may be fairly assumed that the stars are not, generally speaking, removed to greater distances than are required by those physical laws to which, in common with all created matter, they are obedient. HENRY J. EVANS.

1125 Paseo, Kansas City, Mo., April 18, 1906.

P. S.—Since writing the above, I have referred to the article, by Prof. Larkin, which appeared in the SCIENTIFIC AMERICAN of February 3, 1906, and taking the figures there given (which are based on a light velocity of 186,000 miles per second) I find that, if the earth be supposed at a distance from the sun of exactly one inch (which would give a scale of 93,000,000 miles to the inch) the fixed stars would, on this scale, be located at distances in miles corresponding with remarkable precision to their light years.

How One Tree Can Grow Within Another.

To the Editor of the SCIENTIFIC AMERICAN:

I inclose herewith a singular proof of your opinion as expressed in the accompanying cutting concerning the possibility of one tree growing inside another.

My wife and I discovered this phenomenen while making a walking tour in Japan in 1895. As is usual with natural curiosities in Japan, there was a small

A CURIOUS OLD CRYPTOMERIA WITH ANOTHER CRYPTOMERIA GROWING WITHIN IT.

Trunk said to be 45 Japanese feet in circumference and the trunk of the inner tree to be 9 feet in circumference. The outer trunk is about 30 feet high. The outer tree was destroyed by the eruption of Osama Yama 130 years ago. The inner tree is about 110 years old.

shrine with stone lanterns, and across the road a tea house for pilgrims. The trees were so curious that we stopped and had a cup of tea and a gossip with the voluble old landlady, while I made the accompanying sketch from a point of view from which it would have been difficult to have obtained a photograph on account of the bad light.

I obtained a photograph from the old woman, and I wrote up the data she gave me on the back of the photograph. I do not remember now the difference between a Japanese foot and an English foot, but it is very small, and to the eye the dimensions would correspond to English measure. F. M. HARBEN,
Commander U. S. N. rtd., late Naval Attaché at Tokio.
14 Rue Cimarosa, Paris, March 2, 1906.

Earthquakes and Dam Construction at Panama.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of March 31 under editorial "Earthquakes and Dam Construction at Panama," you state that "there exists in an ancient church in the canal zone a masonry arch, which is so flat that by all the laws of equilibrium it should long ago have fallen in." I find in the Encyclopædia Britannica, vol. xviii., p. 208, that September 7, 1882, the façade of the cathedral at Panama was destroyed by an earthquake. I also have an impression that a very severe earthquake occurred there in the eighteenth century, but at present cannot verify it.

The Gamboa dam would be 50 feet higher than the dam at Gatun, but I can conceive of no reason why it could not be backed up by as great a thickness of earth and clay. Should the filling be composed of rocks in large masses immediately back of the concrete, then back of that the earth and clay continued, say, 300 feet at the base to 100 feet in thickness at the top, protected by rock fragments from scour in case the water is allowed to flow over the crest, I do not see why the Gamboa dam cannot be made as secure as the one at Gatun.

To my mind the greatest danger from earthquakes would lie in the locks themselves, unless made monolithic of reinforced concrete; to make them reasonably safe from earthquakes their sides and bottoms, unless they rest on rock, should be so thick that they would be more expensive to build than many dams like the one proposed at Gamboa.

If we are to have locks, why not adopt the high-level plan of Bunau-Varilla or Mr. Bates? But would it not be much better to patiently excavate the canal at sea level? SAMUEL F. ADAM.

Franklin, N. Y., April 9, 1906.

Automobile Notes.

The Vanderbilt Cup race will again be run in America this year, over the same course as was used last year on Long Island. The date set for the race is October 6, and the eliminating race which precedes it will take place on September 22. The first five cars that finish in the latter race will constitute the American team, and the choosing of the team will not be left to the racing board of the A. A. A., as it was last year. The requirement of a differential on the cars which compete has been withdrawn. The Darracq car, which won last year, had no differential and, according to the rules as they then stood, it should not have been allowed to compete.

At an automobile meet held on Ventnor Beach, at Atlantic City, during three days of last week, Walter Christie with his reconstructed double-end, direct-drive, 110-horse-power racer, proved his claim that he has the fastest American racer by carrying off all the speed records. On April 26, the first day of the meet, he lowered the best previous record of a mile from a standing start by 1¼ seconds. He covered the distance in exactly 53 seconds, or at a rate of speed of 67.92 miles an hour. The second day of the meet he beat the 30-horse-power Darracq racer, which won the last Vanderbilt cup race, twice in two heats of the mile race for heavy-weight gasoline cars. Although neither racer made very fast time, Christie covered the mile in 46 2-5 seconds, and beat the Darracq in the final by about two feet. On the last day Christie made a new record for the beach by driving his car a mile in 35 1-5 seconds, or at the rate of 102.27 miles an hour. His nearest competitor, the 80-horse-power Darracq, covered the distance in 39 seconds, or at the rate of 92.36 miles an hour. A stripped English Daimler touring car made a mile in 55 4-5 seconds, which was at the rate of 64.53 miles an hour. Other noteworthy performances during the week were the covering of a mile in 1 minute and 2-5 of a second, by the middle-weight Reo Bird racer, fitted with two 16-horse-power double-opposed-cylinder Reo engines; and the covering of a mile in 1 minute and 36 seconds by a 10-horse-power Maxwell runabout, using kerosene oil as fuel. This was better time than was made by another Maxwell car using gasoline, although the best time made by any of these runabouts was 1:25 3-5, the car being driven by Mrs. J. N. Cuneo. A considerable number of races were run by standard touring cars, but in none of these were any records of special interest made.

A Contest of Spring-Wheel Cars.

An automobile event of a novel character is the concourse of spring-wheeled cars which will be held in France over a distance of 1,200 miles. Starting from Paris, the cars will make the trip to Lyons, Marseilles, Nice and return. Eight days, with distances under 240 miles a day, has been decided upon, starting on the 18th of April. Two main classes of spring-wheeled cars are provided, and each class is divided into two sections. The first class includes wheels having elastic tires (no pneumatics) but no other elastic parts. In the second class are the spring wheels proper, having the elastic part between the hub and the tire. The first sub-section of each class takes in the cars whose total piston surface does not exceed 50 square inches, or for a four-cylinder motor a maximum cylinder bore of 4 inches. The total weight of the car in running order with the passengers and ballast is to be at least 3,300 pounds. In the second sub-section are classed the cars having a piston surface of 82 square inches, or a 5-inch bore for a four-cylinder motor. The total weight in this case is to reach 4,000 pounds. The competitors are to specify the character of the pieces which they expect to replace in the wheels along the route, and also hand in a drawing of the wheel and a complete tire or spring wheel as a specimen.

English shipbuilders in February launched 21 vessels, aggregating about 74,861 tons, as compared with 21 vessels, of 43,694 tons, in January, and 18 vessels, of 40,415 tons, in February last year. In the two months English builders have launched 52 vessels, of 118,555 tons gross, against 44 vessels, of about 93,152 tons, a year ago.

CURIOSITIES OF NAVAL ARCHITECTURE—ROUND SHIPS AND GLOBULAR VESSELS.

BY LIEUT.-COL. C. FIELD.

We have all heard of the "Three Wise Men of Gotham," who "went to sea in a bowl," and doubtless we have, most of us, tempered our sympathy with their fate with the reflection that on this occasion their wisdom was at fault or they would not have tempted Providence in such an unsuitable craft for ocean travel. But were they so very foolish after all? Is a round vessel necessarily unseaworthy? At one time and another there have been found a good many people ready to answer this question in the negative. The late Mr. John Elder, for instance, a noted shipbuilder in his day, was at one period a strong advocate for the construction of circular ironclads. Two warships of this kind were actually built by the Russian government on a modification of his plans. After all, a circular vessel is anything but a novel idea. Herodotus says: "Vessels that sail down the river to Babylon are circular and made of leather;" and, strange to say, such circular boats, made of a framework covered with skins, are in use at Bagdad at the present day. Perhaps, though, we ought not to consider any survival strange when we consider that we are dealing with the "unchanging East."

Somewhat similar, though much smaller, are the round coracles used in the East Indies to pass the rocky rapids of the Boani River. These little vessels are made of split rattan covered with oilcloth. They are called "parachals" and are in the form of a shallow saucer about two feet ten inches in diameter and only seven inches deep. Their crew consists of one man, who steers with a small single-bladed paddle. In this connection we may note that the coracles that have been in use in some parts of Great Britain for thousands of years are, though not circular, yet very nearly as wide as they are long.

In the early days of sailing ships—at any rate in European waters—the "round ship" was a usual and distinct type as opposed to the galley class of vessels, which relied principally on the oar for propulsion and were called "long ships" in contradistinction to the others. This merely referred to their shape and had nothing to do with the modern naval phrase which stigmatizes an inhospitable ship as "a long ship," the interpretation being that it is a vessel in which there is "a long time between drinks." We may note in passing that a completely circular vessel was sometimes used to carry war machines as in the accompanying illustration.

One has only to look at the ancient pictures of sea-fights in the middle ages that have come down to us to see that the single-masted "cogs" or "coques" that were the battleships of that period were very much of the shape of a walnut shell and though not actually circular were very much more nearly round than approximating to the shape of modern ships. But as the progress of navigation and improvements in the rigging of sailing ships brought the sailor's art nearer to perfection, so the advantages of a longer and narrower hull became apparent. The introduction of steam accentuated this, and now for many years ships and steamers have shown a tendency to increase in length in greater proportion to their breadth of beam. The advent of armor and very heavy cannon in warvessels and the advantages of turning easily to use and avoid the ram, for a time restricted this tendency in the case of men-of-war. It was at this period that certain naval officers and warship constructors pushed the idea of a wide beam giving a steady platform for heavy guns and with great powers of flotation to an extreme and advocated the building of circular ironclads.

The "Trident," a Proposed Globular Ship.

Mr. John Elder, as noted above, was one of the first apostles of the circular ship about 1868. He designed one in the first place which was to act as a ferryboat between Liverpool and Birkenhead, arguing that the round form of vessel could carry far more in proportion to its weight and given draft of water than could any other form. He also made plans for circular sea-going and coast-defense warships.

Later on, in 1873 and 1875, Russia launched the ironclads "Novgorod" and "Admiral Popoff" in the Black Sea. These circular ships, which were specially intended for the defense of the River Dneiper and the Sea of Azoff, were built from the designs of Vice-Admiral Popoff and for a time were considered to mark an advance in naval construction. But it was not for very long and both have now for some years been removed from the effective list. The "Novgorod" had a diameter of 101 feet and drew about 13 feet of water. She had a displacement of 2,490 tons, was plated with 9 inches of armor and carried a couple of 11-inch guns in a central barbette. The "Popoff" was a rather bigger vessel, having a diameter of 121 feet, a displacement of 3,550 tons, 11-inch armor, and 12-inch guns. Neither of these quaint monsters of the deep was capable of steaming more than six or seven knots, although each was provided with no less than six propellers. Their shape, of course, heavily handicapped them as regards speed. In their particular case, however, this was not a serious drawback and was more than counterbalanced by their great steadiness and light draft of water, which would enable them to fight at an advantage in the defense of rivers and estuaries, for which purpose they were especially designed. Mr. E. J. Reed, the eminent English naval constructor, who took a trip in the "Novgorod," says that with a strong breeze and a considerable sea the "vertical rise and fall in the center of the vessel seemed absolutely *nil*," and "I, who seldom escape some sensation of sickness at sea, felt perfectly at home and comfortable, throughout the voyage."

Capt. Doenvig's Life-Saving Globe.

Possibly it was this feature in the "Popoffkas"—as those ironclads were called after their designer—that led to the building of the famous yacht "Livadia" for the Czar of Russia. This was a most extraordinary vessel. She did not give one the impression of being a round ship, as her bow and stern overhung the water like those of an ordinary vessel, but that portion of her which floated in the water was almost, if not quite, circular. Her bottom was absolutely flat, and she had three funnels placed abreast in the center of the ship. She was built at Govan by John Elder & Co. and launched in 1880. She had a displacement of 4,000 tons and steamed about ten knots an hour. Far from realizing the expectations formed of her, the "Livadia" proved a thorough failure, was removed from the list of imperial yachts, and having been re-named—appropriately enough, the "Opyt" (Experiment)—she was told off as a transport. As she is said to be capable of carrying 4,000 men it is possible that she has at last found a sphere of usefulness.

The Yacht "Livadia."

One of the naval officers to whom the novelty of the Russian circular ironclads greatly appealed was Commander—now Admiral—Sir G. H. U. Noel, R.N., and in his essay on "The Best Types of War Vessels for the British Navy," for which he gained the Royal United Service Institution's medal in 1876, he advocated "mastless circular vessels for coast defense." His ideal was a completely armored ship of 8,500 tons and of 210 feet diameter armed with a dozen 12-inch guns. It is interesting to note that as regards this point in his design his ideas of nearly thirty years ago agree with our very latest theories. The enormous "Dreadnought" will carry only guns of this caliber and no medium artillery at all. Capt. Noel's ironclad was to be, in short, a big circular floating fortress whose sloping armored sides gave very great protection from fire and whose sharp armored edge where the upper slope met the outward slope of the saucer-like underwater part of the hull, would, he contended, render her, if not invulnerable to the ram, at least a very dangerous ship to attack with that weapon. His views receive a certain amount of corroboration from the fact that the edge of the armored deck of the unfortunate "Victoria" cut completely through the stem of the "Camperdown" when accidentally rammed by her on that disastrous day off Beyrout in 1893. The twelve big guns were to be mounted on disappearing carriages, coming up to fire over the top of the iron rampart and sinking down to be re-loaded under its protection. The more upright part of the breastwork was to be made of 14-inch armor, and the sloping portions, as well as the under surface next the edge of

RECENTLY PATENTED INVENTIONS.

Electrical Devices.

ELECTRIC SWITCH.—L. R. BROWN, South Orange, N. J., and F. H. WENTWORTH, New York, N. Y. The principal objects of the invention are to provide means for making and breaking contact and leaving the various electrical connections of the device in such condition when not in use that no current will flow through them; further, to provide means which can be operated by the time-clock or similar device for operating both making and breaking parts and for providing a switch which can be used in any kind of electric circuit and for operating any kind of an electric instrument.

Of Interest to Farmers.

BELT-REEL.—D. F. GEIGER, Barlow, N. D. In this patent the invention relates to improvements in reels for winding up and holding driving-belts on shredders, threshing-machines, and the like, the object being to provide a reel of simple and novel construction and so arranged that a belt may be easily wound thereon. The frame preferably consists of angle-iron; but it may be of wood and otherwise shaped.

Of General Interest.

ART OF MINING.—A. G. PARKER, Platte Center, Neb. In this case the invention relates to mining, and particularly to the removal of placer deposits. It is particularly applicable to the working of placer-deposits which have already been mined by the ordinary methods, these not permitting the effective removal of the auriferous sands from very irregular surfaces or those in which there are abrupt depressions. In this improved method the nozzles may be introduced into any recesses and contents entirely withdrawn. New placer claims may be equally well operated upon, and in this case a much greater profit will result.

CLAMPING DEVICE.—A. E. BROWN, Brookfield, and C. H. RHODES, Herkimer, N. Y. This invention relates to clamps such as used by silversmiths or goldsmiths in delicate soldering operations or similar work connected with their arts. The invention is intended especially to be used in connection with the repairing of spectacles, eyeglasses, delicate chains, or similar articles. While the invention is intended especially for use in the connection suggested, it should have a wide general usefulness in the arts where similar functions are to be performed.

CONVEYER.—H. BROWN, New York, N. Y. The principal object of the invention is the provision of automatic means for depositing the material upon the desired floor of a building whether the material is being raised or lowered. It relates to a conveyer of that class known as "vertical" conveyers which is provided with a series of horizontal pans or shelves for carrying the material to be transferred.

PULP-SCREEN.—C. E. CHAPMAN, Fort Edward, N. Y. A purpose of the inventor is to provide a construction especially adapted for screening paper-pulp, wherein as the fluid leaves the pulp upon a screen the slivers will be constantly tossed up and down, separating and drying them. Another, is to provide for such action upon the slivers through the simultaneous contrary movement of series of paddles located between the screen proper and independent thereof, which paddles operate in a body of water also beneath the screen proper.

MAIL COLLECTION AND DELIVERY BOX.—J. I. FULLWOOD, Cedartown, Ga. Mr. Fullwood's object is to provide novel simple details of construction for a mail box to be carried in or on a suitable vehicle which affords safe and very convenient means for holding collected mail-matter and also for distributing other mail-matter addressed to patrons living on rural delivery and mail routes traversed by Federal mail-carriers.

LIFE-SAVING RAFT.—H. J. MATSON, Havre, France. The invention pertains to improvements in rafts or similar floats and which are particularly adapted for use on marine vessels, the object being to provide a life raft or float that will be effective for its purpose, simple in its construction, and that will be found equally efficient on being launched either side up.

PROPELLER FOR MARINE VESSELS.—L. D. MALLORY, Longbeach, Cal. This inventor employs a supporting-frame for the operative parts, in which is mounted a right and left hand screw-shaft, through the medium of which the propulsion is effected. He also employs reciprocatory devices for imparting rotary motion to the screw-shaft in either direction, said shaft having coupled relation with the propeller-shaft. Special means are employed for manually operating the reciprocatory devices, as well as for steering the vessel.

ADJUSTABLE SHEET-METAL PIPE.—H. LATIMER, High Bridge, N. J. In the erection of sheet-metal piping, such as stovepipes, considerable difficulty is experienced in forming the joints between the sections, as these joints should fit with nicety though the pipe-sections vary in dimension. The object is to produce a form of pipe which is easily adjusted at its extremities to fit the adjacent sections.

BURNER FOR HYDROCARBON VAPORS.—W. KEMP, Tucson, Ariz. Ter. In this instance the invention has reference to burners, and admits of general use, but is particularly applicable to burners of a type for use in connection with hydrocarbon vapors or the like, and is preferably employed in connection with furnaces for smelting ores.

HARNESS.—C. C. KING, Little Rock, Ark. By the provision of friction-rollers in the stirrups the shaft is permitted to move freely thereover, thus reducing rubbing to a minimum, and by providing a plurality of supports for the stirrup at different points on the back a firmer support for the stirrup is provided, decreasing to a considerable extent the movement thereof and also equalising and distributing the weight of the shaft. The improvement may be applied to existing harness.

SCREEN FOR IRRIGATING-DITCHES.—W. B. RACE, Lake, Idaho. This improved screen is entirely automatic in its action, requiring no attention, the rubbish being released when the water above the screen attains a predetermined level, and the height of the level may be regulated by the length of a depending-bar which projects below a cross-bar. By inserting a pin in different holes a greater or less extent of the bar may be allowed to project below the cross-bar, and as a consequence the catch will be released at a greater or less height of the water above the screen.

MAILING-ENVELOP.—J. SAWDON, Stronghurst, Ill. This invention relates more especially to envelops employed for mailing third and fourth class matter, such as catalogues, merchandise, etc. The object is to provide an envelop for this purpose in which provision is made for the binding of the contents of the envelop and fastening of the same to the envelope. A further object is to relieve the envelop of the strain of the fastening device.

METHOD AND MEANS FOR PROCURING WATER FOR IRRIGATING AND OTHER PURPOSES.—I. TEILMAN, Fresno, Cal. The inventor's object is to provide improved means arranged to utilise the fall of water in a waterway for operating pumps employed to lift the water from the well to the head of the waterway, the water discharged at the foot of the waterway being utilised for irrigating and other purposes.

AUXILIARY RUDDER.—W. M. TAYLOR, Mecklenburg, Va. This improved rudder, while simple in construction, is yet efficient in operation, and when the desired end is attained it is very quickly drawn out of action, which is a most important feature in devices of this class. Owing to its peculiar construction, the action of the flowing water helps to close it, as well as to open it, thereby requiring very little power for its manipulation.

Hardware.

DEVICE FOR DRESSING SAWS.—T. W. ROACH, Lyman, Wash. This improvement pertains particularly to a device for use as a gage in connection with the operation of swaging the drag-teeth of cross-cut or drag saws. The object is primarily to provide means which will prevent injury of the cutting-teeth by the application of the gage to the saw.

KEY-HOLDING ATTACHMENT FOR LOCKS.—H. A. SEAGER, Monroe, Wash. Means are afforded by this attachment for holding the key of a lock from turning in either direction when the lock is in locked or unlocked adjustment, thus preventing the door-lock from being unlocked on the outside of the door and also preventing the accidental displacement and loss of the key when the lock-bolt is released from the door-casement.

Heating and Lighting.

HOT-WATER HEATER.—J. A. COPPRIDGE and T. B. STULTS, Roanoke, Va. The inventor's object is to provide a novel construction for heating the water circulating through radiators and the like for heating purposes. As the fire burns a thin annular sheet of water in the inner compartment of the water-chamber will become heated and rise, the colder water in the outer will enter the inner compartment at the bottom thereof and it is replaced by other water, and so on, as operation proceeds, the inner inclination of the inner-plate increasing heating effect of the fire.

Machines and Mechanical Devices.

CANDY-FORMING MACHINE.—J. A. HOLLOWELL, Memphis, Tenn. The patentee's object in the present invention is the provision of a new and improved machine more especially designed for forming the plastic candy material into sticks of any desired shape and size and cutting the stick transversely into pieces of the desired length.

ECCENTRIC.—F. M. BERGER, Basin, Mont. The design in this instance is to obviate objections to machine-eccentrics in general as same have been heretofore constructed—that is to say, objections to all forms of such devices known to this inventor whereby endwise motion is imparted to a rod or shaft from a driving-shaft having rotary motion and longitudinally disposed at an angle to the driven rod or shaft.

CABLE OR ROPE GUIDE.—G. FRINK, Seattle, Wash. In this patent the invention has reference to logging-machines; and the inventor's object is the provision of a new and improved cable or rope guide or fair-leader arranged to properly lead the cable or rope to the drum of the logging-engine from any direction.

MACHINE FOR CALCULATING INTEREST AND PERCENTAGE.—W. M. BEALY, Blackwell, Oklahoma Ter. The intention of this improvement is to provide a machine adapted for calculating interest and percentage and which at the same time when set to a date from which interest is to be computed will automatically indicate date after date until when the example is finished the day and date to which the interest is computed, together with the time, rate and amount, will appear in full view at the exterior of the machine.

HOTEL-REGISTER.—J. P. HART, Bridgeport Borough, Pa. The leaves whereon names and addresses of guests are inscribed are loose and detachable in place of being bound together, a special means for fastening being employed, whereby they may be quickly separated. The carrier upon which leaves are laid and secured revolves upon a base having an antifriction-bearing vertically adjustable, and between the leaf-carrier and base is interposed an antifriction-bearing, means being provided for holding revolving part central against lateral oscillation. Register carrier has foldable top sections. Closed, they cover and protect the register, the same having spaces for advertisements and ornamental panels.

ADVERTISING DEVICE.—H. A. DE RUDIO, Los Angeles, Cal. The invention relates to advertising by the use of signs. It is especially useful in connection with street-car advertising. The object is to produce a device of simple construction which will contain a plurality of signs or cards carried upon a web, such that these signs may be periodically brought into view.

DOUGH-BREAKER.—L. A. ROCKWELL and J. J. LINDEN, New York, N. Y. This invention refers to improvements in machines for breaking dough for bread-making or the like, the object being to provide, in connection with a machine of this character, a safety device by means of which the operation of the machine may be instantly stopped while the driving-shaft continues in motion should accident or other cause require the stopping.

EXCAVATOR.—A. M. ANDERSON, Moorhead, Minn. The invention relates to excavators, and especially to machinery for making ditches and trenches. It is especially applicable in laying pipe-lines. The machine advances by its own traction when desired. A clutch carried by the engine-shaft enables this traction to be thrown in or out, without stopping the engine. Mr. Anderson has invented another excavator, such as used in railroad construction-work, repairing road-beds, and in the construction of ditches and irrigating-canals. It is also useful for clearing a road-way of ice, snow or similar obstruction.

Prime Movers and Their Accessories.

ROTARY ENGINE.—A. H. WRIGHT, South St. Paul, Minn. This improvement pertains to a rotary engine designed to operate with steam or other elastic fluid under pressure, and it belongs to that class in which the rotating element or rotor turns eccentrically in the stationary casing or stator and carries a radially-movable piston-head, which bears the pressure of the working fluid and transmits the same to the engine-shaft and rotor.

VALVE-GEAR.—W. HARTMANN, Berlin, Germany. In this instance the invention refers to valve-gears for use on steam-engines, gas-engines, and other motors. The aim of the inventor is to provide a gear which is positive in its action, requiring comparatively little working power, and arranged to prevent undue influence on the governor by back strains.

Railways and Their Accessories.

RAILROAD-RAIL JOINT.—E. P. SANDEFUR, Manda, Ky. The purpose of this inventor is the construction of a joint which will stand on a level with the rail under the heaviest train, thereby preventing low joints. The purpose also is to make a joint which will always be ready for use, one which when fastened in its place a train can pass over without danger or delay should the bolts from accident or other cause be out.

CAR-RAIL HORSE-BRIDGE.—J. S. HEATON, Shelbyville, Ky. The invention pertains to improvements in devices for bridges over fire-hose or the like on a car-track, so that movements of cars will not be interfered with during the progress of a fire, the object being to provide a bridge that may be readily put in position and firmly anchored to prevent either lateral or lengthwise movement.

Pertaining to Recreation.

GAME DEVICE.—A. EHRBALD, New York, N. Y. The invention relates to improvements in devices with which a variety of games may be played by any number of persons, the winner being indicated by the highest number on a rotary part that may be disclosed through a chosen opening in the top of the casing when the rotary part comes to rest, the object being to provide a device of this character that will afford amusement with a degree of uncertainty as to results.

GAME-BOARD.—B. F. ELBURN, Chestertown, Md. Mr. Elburn provides a game which will be pleasing and interesting and also an aid in teaching children how to count. The holes in the box-cover may extend entirely through the same. The game-pieces or men can be made in any desired shape or configuration, the only requisite being that each set of six should be of contrasting colors.

THEATRICAL DEVICE.—H. M. PETTIT, New York, N. Y. An automobile or other vehicle is provided with wings and means for spreading and vibrating the wings to give the desired effect, and also means for propelling the automobile along a way or track and for supporting it when removed from the track, so that it may give an appearance of leaping from a cliff to a track located on the opposite side of the chasm at a lower level. Safety devices insure the performance of the act without danger to occupants of the vehicle.

Pertaining to Vehicles.

NECK-YOKE.—C. E. HESS, Saco, Mont. The invention relates to improvements in neck-yokes, and particularly in the connections between the yoke and a wagon-tongue, the object being to provide a novel device for detachably securing the yoke to the tongue without danger of the parts becoming accidentally separated, and, further, to provide ball-bearings for the yoke.

TIRE.—C. MILLER, Binghamton, N. Y. The invention pertains to an improvement in what are known as "cushion-tires," and more specifically to the particular class of cushion-tires in which a resilient core is inclosed in an outer casing and the whole suitably fastened to the felly or rim of the wheel. The object is to increase the resiliency of the tire and to secure it to the felly in such manner as to avoid all danger of creeping or other dislocation of the tire.

BRICK-TRUCK.—M. K. SACHS, Houston, Texas. The invention relates to a truck designed with special reference to the transfer of bricks along a track and on pallets or drying-boards. The principal object is to provide means whereby a truck can be moved under a load, the load readily lifted from its place and left in an elevated position upon the truck, and the truck moved away.

NON-SLIPPING TIRE AND BRAKE.—J. A. YOUNG, New York, N. Y. In the present patent the invention has reference to vehicles, the inventor's more particular object being to produce a wheel provided with a tire constructed for the purpose of preventing slipping and provided with a brake peculiarly adapted for this form of tire.

Designs.

DESIGN FOR A BOX.—W. JOHNS, New York, N. Y. In this instance the ornamental design shows a clock upon the box cover. Two columns rest on a base and support a dial flanked by two smaller columns and capped with a head piece. An original feature is furnished by a mouse climbing a weight chain suspended near the pendulum.

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References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(9955) J. A. K. asks: 1. In your issue of March 24, page 258 (9921), you say that the buoyant power of a tank, open at the bottom, decreases as it is sunk deeper into the water, since water enters and compresses the air into a smaller volume. You say that the above is true, since the only point involved is the volume of water displaced. Is it not the weight, instead of the volume, of water displaced that is involved? Would not the difference in buoyancy depend on the comparative difference in density of air and water, at the surface and at a distance below the surface? If the compressibility of water is greater than that of air, would not the buoyancy increase with the descent of the tank? Which has the greater compressibility—water or air? I have no books which will answer this question for me. If the compressibility of water is less, as your statement implies, why does sound travel a greater distance in water than in air? A. The reply to your inquiry regarding the compressibility of water and air is that water is nearly incompressible, and air is compressed to half its volume by an increase of pressure of 15 pounds per square inch. This increase is produced by sinking the box to a depth of 34 feet in water. When the box is 34 feet below the surface, the air will occupy only half the box; the rest will be filled with water, which is of almost the same density as at the surface. Water is compressed only 44 millionths by a pressure of 15 pounds per square inch. The velocity of sound in water is not due to its density. It travels slower in denser substances. Sound travels much faster in iron than in water or air. The velocity of sound is produced by the elasticity of the substance, as well as by the density of the substance. The velocity in any substance varies directly as the square root of the elasticity divided by the square root of the density. See any textbook of physics. 2. In the same issue, page 258 (9928), you say that July is the midsummer month of the southern hemisphere. Is not the sun directly over the Tropic of Capricorn on December 21, and hence is not December the midsummer month of the southern hemisphere? A. The second item to which you call our attention is a slip in the types. The midsummer in the southern hemisphere is at the same time as the winter in the northern hemisphere. Every one knows that fact, and no one will be misled by the error, which was not detected in reading the proof.

(9956) J. P. M. asks: Would you kindly decide this argument: 1. A says you cannot make water hotter than 212 degrees, as it then becomes steam. B says water can be made hotter than 212 degrees. A. Water cannot be heated above its boiling point in an open dish. When the barometer stands at 30 inches, water boils at 212 deg. Fahr. At the sea level the temperature of boiling water fluctuates about 5 degrees, due to changes in the pressure of the atmosphere in storms and fair weather. Water in boilers can be heated above 212 deg., and is always hotter than 212 deg. in steam engine boilers when steam is up. 2. A argues that all watches are the same as far as works are concerned; that is, a $5 watch or $100 one has just the same amount of works. We do not mean quality. B argues that good watches have extra works in them. A. The works of cheap watches are very coarse and rough. Those of fine watches are highly finished, and run with much more perfect regularity. Some watches have more wheels than others. This is a question the nearest watch repairer can settle for you.

(9957) E. P. writes: In your column of the issue of March 24, 1906 (page 257, query 9919), I notice that you put an interval of 5, 6, or 11 years between years having 53 Sundays. In the list of such years you omit the years 1916, 1944, and 1972. Now these leap years will begin with a Saturday and end with a Sunday, having 53 Saturdays and *also* 53 Sundays—the two extra days a leap year has over 52 weeks. Should not these years be included in the list, and the interval placed at 5 or 6 years only? A. By some inadvertence we missed the leap years mentioned by our correspondent from the list of years having 53 Sundays in the present century.

(9958) B. W. writes: Query 9916, by J. A. R., SCIENTIFIC AMERICAN, March 17, 1906, page 238, "Will you account for the universal idea among seafaring men that ice sinks?" Answer: The floating or sinking of ice in water depends upon the relative specific gravity of each. Clean ice will always float in water, until it dissolves into water. Ice may become so loaded with other matter as to cause its specific gravity to be greater than the water beneath it, and it sinks. My business from 1871 to 1878 caused me much travel over the Missouri River, from Springfield, Dakota, on the north to White Cloud, Kansas, on the south, a distance of about one hundred and seventy-five miles, during all seasons of the year. The Missouri River water is dirt thick. The Winnebago Indians call it Ne-shuda (*shuda*, dirt; *Ne*, water), dirtwater. The river's wide valley is a windy country, and clouds of fine sand may be seen almost daily passing over its waters. It is very winding in its course southward, and has a swift current. Ice upon its surface sometimes forms four feet in thickness, and generally sinks when warm weather comes. The thickness of the ice having then been diminished by the heat, and the sand and dirt upon and within the ice remaining intact in weight, the specific gravity of the remaining ice becomes greater than that of the water, and it sinks. The same rule of nature is applicable to account for the sinking of icebergs within southern latitudes. There ice is slowly formed in glaciers, and weighted by sand and stone ground from the rocks and earth during their gradual descent to the ocean, into which they are dropped. As the iceberg journeys southward into warm latitudes and currents the ice is gradually melted, the stones, sand, and dirt remain in their original weight, the specific gravity of the mass becomes greater than that of the water, and what is left of the iceberg sinks beneath the ocean. "The universal idea among seafaring men that ice sinks" is correct under certain conditions. A. The origin of the univ sal idea cannot be explained by the fact that it is sometimes true in exceptional circumstances. The editor in his boyhood lived near the sea, and also large fresh-water ponds. Every one believed that the ice sank when it disappeared in the spring. The query referred to asks for the origin of that idea, not for an explanation why ice may sink by becoming heavier than water from accretions of foreign matter. That is a very different question. The editor thinks the idea originated from the frequent disappearance of ice in a night during a warm rain, as he has often known it to do. We used sometimes to say it had gone out, sometimes that it sank. Both phrases are in local use. Neither probably is true. The ice disintegrates, or breaks up into prisms and floats in small pieces, so that the surface looks to be entirely composed of water, as it largely is. Seen from a distance one can see no ice. Where has it gone? "It has sunk," say the native and the sailor; while it is really floating just at the surface in small pieces, too small to be seen.

(9959) E. J. writes: I would like you to answer this: I have a core ⅝ inch diameter, 7 inches long, made up of No. 22. The primary is wound with two turns No. 18, secondary ⅝ pound No. 36. I wound two layers, one on top of another, then insulated them. I did this all through the coil. I used 4 and 5 volts in the primary, and have been unable to get a spark ⅝ inch long. I made the tinfoil as per sketch. A. A coil made with a primary with only *two turns* of wire will not give a spark at all. It should contain *two layers* of wire. The use of so much insulation between the layers of the secondary is unnecessary, and reduces the spark, since it removes the wire too far from the primary. To say that you "used four and five volts in the primary" means nothing. If you had said you used so many *amperes*, we could then judge the matter. Two or three good cells will give current enough for a little coil such as you describe. Probably a quarter to three-eighths inch is all the spark you can obtain from it. It is better to get a good book like Norrie's "Induction Coils," which we send for $1.00, and follow the directions carefully in building a coil. Time and money will be saved by first finding out what should be done, and afterward doing it.

(9960) A. N. asks: 1. I am winding the secondary of a 1-inch spark induction coil in four main sections (page 11, Norrie's "Induction Coils"). Would it increase the insulation in each of these sections to wind the wire on in layers, separating each by paraffined paper, or would this heighten the tendency of the spark to jump through it? A. We do not advise you to change the construction of the coil you are making after Norrie's plans. Follow plans closely. Added insulation between layers in secondary is not needed, else Norrie would have said so. You will injure and not improve your coil by putting paper between the layers, because you will separate the layers farther from the primary. The outer layers will be in a very weak magnetic field if you put the paper in as you propose. Follow plans closely. 2. How far will 1-inch spark send a wireless message with the receiver described in SUPPLEMENT No. 1343? A. A 1-inch spark will send a wireless message a great distance, but not the spark from a coil only capable of making a spark 1 inch long. A great coil with the terminals 1 inch apart will have much more power than a small coil will with its terminals as far apart as it can send a spark. A 1-inch coil might perhaps send a signal one mile over water, and 1,000 feet over land. 3. In regard to ohms, would not a fine wire offer less resistance to a small current than a large current? Therefore, ought not some voltage be given in stating number of ohms resistance? A. The resistance of a wire is entirely independent of the current which is flowing through the wire. An ohm is an ohm without reference to the amperes flowing through the wire. Amperes should not be stated; if they should, all the books would state them. The writers know their subject. 4. If a relay is wound for 100 ohms, does that mean it will work through 10 ohms resistance? A. A 100-ohm relay has 100 ohms of resistance in its coils. It is usual to specify the distances to which relays will operate, rather than the resistances through which they will work. With magneto ringers it is usual to specify the resistance through which they will ring. An 80,000-ohm ringer is one which will ring through that number of ohms. 5. How thick glass will 1-inch spark pierce? A. With a proper condenser a 1-inch spark coil might pierce glass a few thousandths of an inch thick, though we have our doubts about its piercing any thickness of glass. We have never tried it, and no data exist for so small a coil. 6. In X-rays, do you take a photograph of the image on the fluoroscope or through a camera, or just let the shadow fall on the plate? A. With X-rays the shadows cast by dense objects are allowed to fall upon a photographic plate which is wrapped in black paper. No camera is used for making an X-ray picture, or skiagraph. 7. In an induction coil, if there is enough current to jump through air, why does not it jump through the thin insulation? A. Paraffine, shellac, and the rest are better insulators than is the air, so that the spark jumps through air between the terminals of a coil rather than through the insulation in ordinary discharges. Sometimes the insulation is pierced and the coil ruined.

(9961) H. T. asks: The "ion" theory suggested to me the following little experiment. Into a drawn-out piece of hard glass tubing of this form put various salt solutions, such as Na_2SO_4, $MgSO_4$, etc., and a very small drop of mercury, just large enough to act as a sort of movable stopper in the capillary tube. In introducing a current of about 8 volts, I found that the mercury traveled speedily toward the electrode and back again, when the current was reversed. If the experiment was carried on for some time, the mercury "thread" seemed to suffer a strain, and frequently broke in two; polarization of the electrodes may have had something to do with that. Has this experiment been tried before, and is there any reason why the metallic ions might not be the cause of the motion of the mercury? A. The experiment you send us you will find in Hopkins's "Experimental Electro-Chemistry," page 12, which we can send you for $3.00. It was published a good many years ago, we think, first by Wallace Gould Levison, in the American Journal of Science. The direction of migration of the mercury to the negative pole indicates that its ions are electro-positive. The tube used for this experiment need not be capillary.

(9962) A. K. D. asks the advisability of using an electric motor in a barn for threshing purposes, to be run by a gasoline engine about 300 feet away, to which a dynamo is attached. The engine develops 18 horse-power. If a 10-horse-power dynamo were used, what horse-power motor could be successfully used? A. We see no reason why an electric motor could not be used in a barn for threshing or running any farm machinery. The commutator could be protected from dust, and the danger from fire be made so small as not to be considered. A 10-horse-power dynamo should deliver 90 per cent of its power, or 9 horse-power, to the motor.

(9963) C. W. says: Inclosed please find ten cents in stamps in payment for the copy of SCIENTIFIC AMERICAN containing your explanation of the so-called puzzle of cutting sixty-four squares to make them sixty-five. I know that you published the correct solution within the last few months, but have mislaid or lost my copy of the paper, so send for one. There are some "wise guys" in this neck of woods who think they can make the extra square out of nothing, and won't believe me until they see your paper. A. The paper you request is SCIENTIFIC AMERICAN, vol. 93, No. 2, issue of July 8, 1905. We publish your letter because letters about this old trick, which seems to die hard, have begun to come into our office again. We wish our friends would believe that it is impossible to make 8 times 8 anything but 64. Credulity seems to be easy in the human mind.

(9964) S. asks: Will you please state whether or not it is possible for a man to take without killing him 75,000 or 100,000 volts of electricity? A. The killing of a man by electricity does not depend upon the voltage of the current at all, certainly not directly upon the voltage. It is the amperes which destroy life by acting upon the nerve centers. The volts simply determine how many amperes shall flow, if the generator furnishes them. This is according to Ohm's law. Amperes are equal to volts divided by ohms. Ohms are resistance. Volts are pressure and amperes are current. This is just like pressure and quantity in flow of water in pipes, and the friction of the pipe to oppose the flow of the water. Now if a generator is able to furnish a large current at a high pressure the man will be killed by it, but if only a small current can be furnished the man may not be killed. If the resistance of the man is large, say 5,000 ohms, and the voltage moderate, as say 500 volts, only one-tenth of an ampere can flow, and that will not instantly kill, but it will give a smart shock. Voltages such as you name are not usually large except upon long-distance transmission lines, and then they are very dangerous, since the amperes are usually large also. But the small generators and the electrical oscillators which have such high voltages have only minute amperages, and a current from these is insignificant and harmless. From what we have said it is evident that volts do not enter a person, nor travel at all. They simply push the current, electricity, along. Men do not take volts of electricity. Men take amperes, and amperes do the work or damage as the case may be.

NEW BOOKS, ETC.

THE ART OF LEAD BURNING. By C. H. Fay. New York: David Williams Company, 1905. 12mo.; pp. 144. Price, $2.

The author justly states that the mystery which has always surrounded the work of the lead burner, like that of all other handicrafts outside of ordinary occupations, dissolves under the light of a full knowledge of the causes and effects that have a bearing upon it. The author has produced a thoroughly practical book which can be used with advantage by the practical mechanic. The greatest field for the lead burner is in the chemical trades. The illustrations are numerous and enlightening.

LIPPINCOTT'S NEW GAZETTEER. A Complete Gazetteer or Geographical Dictionary of the World. Edited by Angelo Heilprin and Louis Heilprin. Philadelphia and London: J. B. Lippincott Company, 1906. 4to.; pp. 2,053. Price, sheep, $10 net; half morocco, $12.50 net; patent index, 50 cents extra.

A noble book, indispensable in every library, public or private, and will be found useful in any office. This work has been before the public for just half a century. The present edition is not the usual patched-plate book, but is a brand new edition, being printed from new type from cover to cover. This publication is an accurate picture of every corner of the globe in its minutest details as it exists in the twentieth century. Statistics of population, production, mining, manufactures, physical history, exploration, general history, etc., have been gathered from the latest official censuses, domestic and foreign. Each one of its 100,000 notices, varying in length from a single line to thousands of words, speaks for itself. A vast amount of labor has been expended in search of special information not to be found in official reports or the ordinary books of reference.

TECHNISCHES UND TÄGLICHES LEXIKON. By Oscar Klinckfieck. Berlin: Boll & Pickardt, 1906. Pp. 48. Price, 2 marks per installment.

This technical and practical German, English and French dictionary is to be published in some seventeen installments of about 48 pages each. The author's professional and technical experience has enabled him to produce a book which promises to be of great value not only for purposes of translation, but in general technical literature as well. At the present time the first two numbers have been issued. As the title indicates, the book deals principally with technical terms, including those of military, naval, and general scientific pariance, but it will undoubtedly be extremely useful in the discussion and translation of many practical industries and arts, as well.

VENTILATION OF BUILDINGS. By William G. Snow, S.B., and Thomas Nolan, A.M., M.S. New York: D. Van Nostrand Company, 1906. 32mo.; pp. 83. Price, 50 cents.

Messrs. Snow and Nolan have concisely and clearly defined the essential principles of ventilation in this practical little book. The mechanics of the science have not been gone into, but have been left for another volume in "Science Series." The work deserves wide circulation, particularly among members of boards of health, physicians, and others where time is lacking to go thoroughly into the theory and principle of the subject, and where a practical handbook is a first requisite. It also might well be used in medical and engineering schools where this important subject is not dealt with exclusively as a division of the curriculum.

STEAM TURBINES. By Carl C. Thomas. New York: John Wiley & Sons, 1906. 8vo.; pp. 287. Price, $3.50.

Prof. Thomas, well known as a member of the faculty of Sibley College, Cornell University, has produced in this book a theoretical work on the subject of the steam turbine of no little value. The book is well illustrated with diagrams and engravings, and treats the difficult subject in a clear and brief manner. It is not a handbook for the use of the untrained, practical engineer, but is of undoubted value as a text book for theoretical study. Prof. Thomas, despite the fact that the development of this particular utilization of steam has been so rapid that many of the problems involved are still to be solved satis-

the circumference, to be 3½ inches thick. She was to have four keels, three propellers, and two rudders. This class of fighting ship has not hitherto materialized and there is nothing in the lessons of the recent Russo-Japanese war to make us think that we shall see anything of the kind in the immediate future.

But the circular form still has its attractions for the inventor, and only a year or two ago another circular—nay, almost globular—iron-clad was designed by a Mr. Stokes, of New York. This modern Gothamite, determined to emulate his famous predecessors, intends his bowl to be the exact shape of an ordinary gas globe inverted. He claims that this will give the maximum of buoyancy and armor-carrying capacity. She is to be a much bigger affair than the "Popoffkas," having a displacement of over 11,000 tons. The "Trident," as she is christened by her inventor, is to have an armor belt no less than 18 inches thick extending from considerably below the water line to a few feet above it, where she is encircled by a gallery or balcony. Above this everything is to be protected by 12-inch plating. She is to carry a pair of 15-inch guns fixed immovably in their places, so that to direct them to the right or left the vessel must be bodily revolved in the required direction, while elevation or depression are to be obtained by tilting the ship by movable counterpoise weights which are provided for the purpose. She is to have three smaller guns in fixed turrets, and an armored conning tower. There will be no ports or scuttles in the "Trident." Air will be obtained by a system of ventilation from the upper deck, while for light the ship's company will have to be contented with incandescent lamps. Her four propellers are placed equidistantly round her hull and enable her to turn round on her axis to direct her guns, and possibly may enable her to crawl through the water.

Circular Medieval Vessel with Stone-Throwing Engine.

An Italian engineer, Signor Piatti del Pozzo, not very long since applied the principle of globular construction to a species of submarine boat which he termed the "Pozzo submarine worker." As its name implies, this queer spherical craft is not intended so much for traveling as for building and salvage operations below water. So while rapid progression is not possible, the shape gives strength to resist the pressure of water, so that work can be carried on at greater depths than with other contrivances. The craft is made of stout cast iron and weighs six tons. It can move about by the aid of a rudder and three screws driven by electricity and descends by the simple method of attaching a receptacle holding sufficient ballast to overcome its buoyancy. When it is necessary to ascend this weight is disconnected by means provided inside the "Worker" and she "bobs up serenely from below."

The two latest attempts at globular vessels are the "Doenvig life-saving globe" and the "auto-propulseur Adam-Boudin," an extraordinary ball-like affair that trundles itself along the surface of the water. It consists of an inner and an outer sphere. The outer, which is provided with a kind of ridge or keel and a series of fans or blades, revolves upon bearings on the inner one and so moves the whole boat—if boat it may be called—along in the water. The engines of 24 horse-power and the unfortunate passengers are boxed up in the inner ball, access to which is obtained through a manhole at the axis. There must be many pleasanter ways of "going down to the sea in ships," and it is to be feared that this weird vessel will never make its inventor's fortune. It is, indeed, difficult to understand what advantages it presents for any purpose whatever.

The "Doenvig globe" is especially intended for carrying on board ship as a kind of life-boat in which the crew and passengers may escape from the violence of the tempest that has wrecked their vessel. She has some hand-worked means of propulsion which is said to give her a speed of 2½ knots under favorable circumstances. A couple of triangular sails are attached to a central ventilator which serves also the purpose of a mast. Inside there is a deck surrounded by a ring of provision lockers forming a circular bench, while below this compartment is a reservoir of fresh water. There are three scuttles in the upper part of the globe, where also is situated the manhole through which the shipwrecked mariners can get inside of this odd vessel. She has been tested and seems to answer the purpose for which she has been built very well. It is evident that, properly trimmed and ballasted, a globular vessel of this kind could not lose any of her buoyancy by taking in water in roughest weather and would ride comparatively steady over the heaviest seas. This and the "Pozzo submarine worker" appear to be about the most useful and practical of the circular and globular craft that have been evolved from the ingenious brains of our modern inventors. Whether the building of similar vessels of a bigger and more powerful nature will ever be undertaken on any great scale is more than doubtful. Occasionally some such eccentricities of naval architecture may be designed and even constructed; but they will remain eccentricities, and will serve only as the exceptions to prove the rule that the elongated hull with a flat deck must always be the best type of vessel.

Circular Boats on the Euphrates.

Circular Coracle Used on the Beani River.

The "Popoffkas": "Novgorod" and "Admiral Popoff."

The "Auto-Propulseur" "Adam Boudin."

Admiral Noel's Proposed Circular Ironclad Battleship.

CURIOSITIES OF NAVAL ARCHITECTURE--ROUND SHIPS AND GLOBULAR VESSELS.

HOW TO CONSTRUCT AN EXPERIMENTAL POLYPHASE MOTOR.

BY A. W. FORSTALL, S. J.

The polyphase current motor, though in more ways than one the motor of the future, remains comparatively little known. Nor are reasons for this rather negative state of mind far to seek. There is, first of all, the widely prevailing idea that the production of polyphase currents presupposes what is technically known as a polyphase generator, a costly machine, which but few are able to provide themselves with. But entirely apart from all such material considerations, the ordinary experimenter is simply overawed by the formidable problem of that intangible difference of phase, which as a matter of fact must be exactly one-fourth or one-third of a cycle. In other words, if 60 cycles are passed through in one second, the operator must secure a lag of one current behind another, corresponding to an interval of time not exceeding 1/180 of a second.

The difficulty here calling for solution is kin to the mechanical difficulty which presented itself in the early days of the steam engine. Though sufficient steam was turned on, the engine would frequently refuse to start; it had stopped on a dead center. What was done to prevent this embarrassment? The trucks were fitted out with two cranks at right angles to each other, so that the impulse of one would be given a quarter of a period later than that of the other. Similarly, the armature of a diphase motor will not rotate, if it receives the oscillatory impulse of only a single alternating current; and even when two impulses are given it from two alternating currents that are moving perfectly in step, one with the other, increasing or decreasing their values at exactly the same time, no torque will be produced, and consequently the armature will not turn. But if the impulse of one current is made to be at or move toward its maximum, while the impulse of the other is passing through its minimum value, then the armature, even under a proportionate load, must immediately begin to turn. This coincidence of different values of the impulses of two alternating currents is precisely what is meant by the difference of phase between two currents, or the lag of one behind the other. Hence, to make two currents diphase, the mechanical disposition referred to as applied to the steam engine must in some way be realized electrically.

In the commercial "diphaser" (a generator so constructed that it delivers two alternating currents differing by just one-fourth of a cycle) the characteristic feature is, that it is fitted with two similar armatures mounted on the same shaft, one of them, however, being shifted angularly in respect to the other, so as to generate two currents with the proper relation of phase. But there is a way of generating diphase and triphase currents, without the use of such diphase and triphase generators. If the reader is interested in the theme of this article, he should read carefully the experiments of Mr. N. Tesla, which are described minutely in No. 944 of the SCIENTIFIC AMERICAN SUPPLEMENT (February 3, 1894). Mr. N. Tesla clearly establishes the fact that a polyphase generator is not indispensable to operate a polyphase motor; he makes one alternating current from an ordinary uniphase generator serve the purpose of a polyphase generator, by dividing the current into two, and securing to the one the proper degree of lag relatively to the other. To explain how this simpler kind of polyphase arrangement can be constructed and adjusted, very much more easily and cheaply than one would on first thought imagine, is the adequate *raison d'être* of the present essay.

The small motor represented in the accompanying illustrations was actually constructed at a trifling cost, and without the use of any delicate measuring instruments. The finished machine (but without the electro-magnet and a few accessory parts) is exhibited in Fig. 2. The general disposition of the diphasing apparatus will be readily understood from an inspection of Fig. 1. *A* is the knob at which the uniphase alternating current (104-volt, 60-cycle) has been tapped. At *O* this current is divided, one portion being conducted through wire *J*, electro-magnet *M M'*, field coil *C;* the other portion through wire *I*, resistance coil *R*, field coil *C'*. At *O'* the two are again united in one wire with exit at knob *B*. Now, if one of these currents between *O* and *O'*, say the lower *O I R C' H O'*, is made to lag behind the upper *O J M M' C L O'* exactly one-fourth of a cycle, then the space at *a*, where the axes of the two coils meet, will be the seat of a diphase rotating field, and in consequence, any suitable armature supported there so as to be free to rotate must, owing to the torque to which it is subjected, spontaneously begin to revolve. In our case the difference of phase is a function of two properly varied factors: the self-induction of the upper circuit and the resistance of the lower one. The self-induction of the first circuit is constituted partly by the electro-magnet, *M M'*, and partly by the field coil *C*. The resistance of the second is *R*.

Out of stiff thin pasteboard make two tubes, each 3.5 inches long and about 0.75 inch in diameter. Around each of these tubes wrap about 33 feet of No. 22 copper magnet wire (B. & S.), allowing the ends to project 4 inches. Next provide these coils with laminated iron cores, constructed as follows: Take a ribbon of Russian sheet iron (such as is used for stove and furnace trimmings) 18 feet long and a trifle less than 0.5 inch wide. Cut it into 50 (25 for each core) rectangular pieces, each 4.25 inches long. Prepare also 48 (24 for each core) pieces of paper, slightly longer and wider than the iron rectangles. Of these pieces of iron and of paper make two equal piles, placing iron and paper alternately. After filing these cores true and wrapping each tight with tape, insert one into each of the tubes, and you have your field coils finished. As for the resistance *R*, one of the flat coils used by tailors for heating their irons by electricity will answer the purpose very well. They are generally 3 x 3.5 inches, and are on the market for 50 cents and upward. The electro-magnet on the upper circuit is made up of 25 pounds of No. 12 copper magnet wire (B. & S.) corresponding to a resistance of 2 ohms. This was found to be more than enough to prevent heating. It may be well to note that the self-induction of the field coil alone without that of this electro-

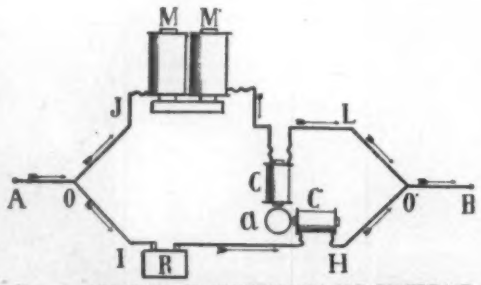


Fig. 1.—DIAGRAM OF CONNECTIONS FOR POLYPHASE MOTOR.

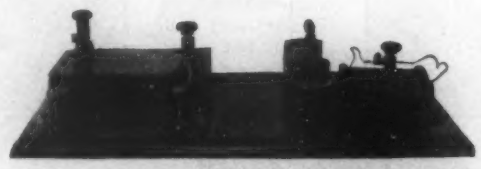


Fig. 2.—AN EXPERIMENTAL POLYPHASE MOTOR.

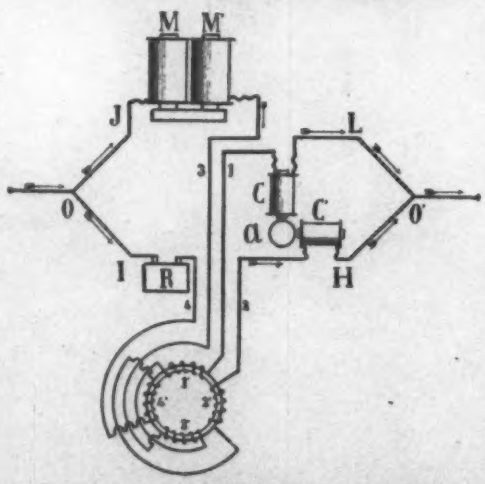


Fig. 3.—DIAGRAM OF CONNECTIONS FOR FOUR-COIL CIRCULAR FIELD.

magnet would suffice. In fact, if no electro-magnet is at hand, a second heating coil similar to the first may take the place of the electro-magnet.

Now connect everything as in Fig. 1. To test these circuits, turn on the current for only a few seconds. Should undue heat manifest itself in any part of the circuits, a few yards of German silver wire inserted into that circuit will bring the local heat under control. When the heat is not too intense after the current is on for three or four minutes, you may proceed to the final adjustment, namely, the securing of the required difference of phase between the two circuits.

This apparently over-delicate task is accomplished quite easily by tests with any small magnetic compass. (Should you have none at hand, make one. Magnetize by friction a piece of watch-spring one inch long and weighing one gramme or so; to make it balance, and to enable it to swing horizontally on a vertical axis, make a small indentation at its center.) Set the compass on a plane with the cores of the field coils, and at the point where the axes of the cores meet. Turn on the current; with the point of a pencil spin the compass rapidly on its support. The needle may possibly rotate so regularly that it overcomes all dead points, and so briskly that it is invisible. In this case, you need no further test; you have struck the proper relation of phase that must exist between the two currents. It is more likely, however, that the needle will move only slowly and irregularly or only quiver. Should it manifest a decided tendency to move in one direction, try to help it on by removing from or adding to the coils of the upper circuit a moderate length of wire. Once you notice that the tendency to turn in either direction is given or increased by adding to or subtracting from the coils in one circuit, or by increasing or diminishing the resistance *R* in the other, continue this process of adding or subtracting, until the needle rotates as above described. The principle constantly applied in this last adjustment is this: an increase of self-induction in the upper circuit increases the difference of phase between its current and that of the line; while an additional resistance introduced into the lower circuit diminishes the difference of phase between this current and that of the line. Thus the increase of either factor produces a greater difference of phase between the two circuits of the field coils.

The motor is now adjusted. Remove the compass and put in its stead the armature, a circular piece of soft iron 1.25 inches in diameter and a little less than ⅛ inch in thickness. You may vary your experiments by using armatures or rotors of different types and materials. When needed, a short piece of glass tubing sealed at one end may be inserted through a hole in the center of the disk, to serve as a bearing. Always set up the armatures as was directed for the compass.

A very interesting and highly instructive addition to the motor just described will be a four-coil circular field, as shown in Fig. 3. The core of this is constructed in a way similar to that in which the field coils of Fig. 1 were constructed. Take a continuous ribbon of sheet iron about 0.5 inch wide and 18 feet long, and also a ribbon of paper slightly wider. Make the first turn of iron so that the diameter of the inner circular field will be 2 inches. Roll up the iron ribbon so that each turn of iron will be separated from the next by paper, until you have a ring of square section. Wrap this ring core with tape. To provide the proper coils, divide the core into four equal sections marked in order 1', 2', 3', 4'; only the two middle quarters of each section are to be covered by the coils, 16.5 feet of No. 25 copper magnet wire being wrapped around that portion of each section. Coils on sections 1' and 3' must be wound in exactly the same way; those on sections 2' and 4' must also correspond to each other. If you begin wrapping section 1' say from the side toward section 2' and make turns of wire clockwise, then section 3' must also be begun from the side toward section 2', and the convolutions of its wire must also be clockwise, so as to develop two poles of the same name on the same side of the armature. If you begin section 2' say from the side toward section 3' and make the convolutions the reverse of clockwise, then section 4' must also be wrapped beginning from the side toward section 3', and the convolutions must be made as in winding section 2', so that this set may also develop two poles of the same name on the same side of the armature. At the beginning and at the end of each coil allow the wire to project about 4 inches. Then connect the wire projecting at the end of coil on section 1' with that projecting at the beginning of coil 3', bringing the wires around the outer rim of the core. Insert these two coils thus compounded into the circuit of say field coil *C*, between *C* and *M'*. Connect coils 2' and 4' into a compound coil, and insert it into the circuit of field coil *C'* between *H* and *R* of Fig. 1, exactly adapting the directions given for connection and insertion of coils 1' and 3'.

You have now a four-coil armature; each single coil develops two poles, hence there are in all eight poles. But, owing to the special winding, the four poles of coils 1' and 3' are gathered into two, one located at the middle of section 2', the other at the middle of section 4'; and in the same way, the four poles of coils 2' and 4' are gathered into two, one located at the middle of section 1', the other at the middle of section 3'. Moreover, even these two sets of compound poles finally merge into two, one north and the other south. So this four-coil armature produces an eight-pole field, if you simply count the magnetic poles generated; but these reduce themselves to a two-pole rotating field.

On a vertical pivot at the center of the four-coil field set up different kinds of armatures, and they will rotate under the influence of the two-pole diphase field. Thus, try an armature in the shape of a hollow cylinder of brass or copper one inch long and one inch and a quarter in diameter (Arago's rotations). Put a cork into the cylinder and a glass bearing in the cork. (Less than 10 grammes in all.) Another armature might be a small rectangular plate of soft iron 1.5 inches long wrapped at each extremity with 6 feet of No. 25 copper magnet wire, so as to develop two consequent poles. The piece of iron may be 0.25 inch wide and ⅛ inch thick. It will also need a glass bearing. The brass and even the copper armature will not revolve very fast in the circular field; they will not revolve at all

in the field of Fig. 2. It is this very experiment which for a long time puzzled Mr. W. de Fonvielle while he was conducting his known researches of 1880.* All the other armatures to be used here must be more carefully balanced than those used in the two-coil field of Fig. 2, since the effects produced in the circular field are notably more energetic.

This inexpensive motor, working satisfactorily as it does, will illustrate many principles bearing on the theory of polyphase machinery, and in particular those involved in experiments such as the following: insufficiency of an oscillatory field to produce rotation; character of rotating fields; effects of self-induction and resistance on the difference of phase; bipolar diphase motor; four-coil diphase field; rotation of magnetized and non-magnetized armatures; Arago's rotations; reactions of Foucault's currents on the field; synchronism and asynchronism; three-wire diphase arrangement; reversal of rotation; self-starting, slip, etc.

Thus our experimental motor, though not recommended as having any commercial value, will yet be found very serviceable in the lecture room.

THE SENSE OF SMELL IN SNAILS.

BY DR. ALFRED GRADENWITZ.

In the higher animals the various senses are localized in separate organs. This distribution, as we go down the scale of animal life, becomes less and less specialized, until in cellular forms it is hard if not impossible to distinguish any special sense organ. Mollusks may be said to occupy an intermediate position on this ladder of evolution. While they are in a measure possessed of true organs of sense, still these organs answer other purposes besides responding to sensations alone. An interesting instance of this behavior is afforded by *Helix pomatia*, the common snail, which has been recently made the subject of an extensive investigation by Prof. Emile Yung, of the University of Geneva, Switzerland. While previous naturalists had ascribed to the snail a strong sense of smell, it was not known where the sense organ was located. Prof. Yung shows that the sense is distributed over the entire body, in so far as it is not covered by the shell. Some parts, however, possess the sense of smell in a particularly high degree, viz., the two pairs of tentacles, the lips and the edges of the feet.

The following is one of the experiments made by Yung in carrying out his investigations. When a brush wetted with a drop of water was brought near a snail, immediate contact was necessary to produce a visible response, except in the case of the large tentacles which also contain an eye. Whenever the brush was brought within 1 millimeter of the eye, the tentacle was perceptibly deflected. Evidently this effect could be produced by the sense of sight, of heat, or of smell. Special experiments, however, proved the first two hypotheses to be inadmissible. Hence the sense of smell must be the cause of the snail's aversion.

In further investigating this sense Yung substituted camomile essence for the water. The odor was perceived at a distance of 4 millimeters. Whenever the brush was brought nearer to the animal (see Fig. 1), the tentacle would be deflected. Similarly the back would be depressed and the edge of the foot would be turned, when the camomile essence was brought near these parts of the body (see Fig. 2).

* Comptes-rendus de l'Academie des Sciences, 1er Semestre, 1880, p. 801.

Clearly the sense of smell is spread over a wide area. It may, however, be said that when repeating the same experiment, the response was found gradually to decrease in intensity, the snail becoming used to the stimulus. The sense of smell among lower animals

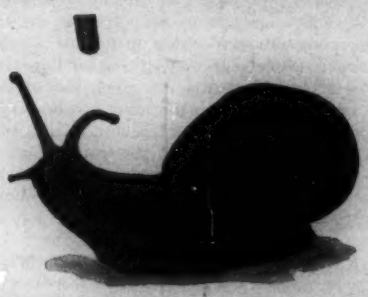


Fig. 1.—Snail Deflecting Left Tentacle at a Distance of 4 Millimeters from a Glass Rod Dipped in Camomile Essence.

plays an important part in the quest of food. Experiments made in this direction by Prof. Yung showed this rôle to be quite secondary in the case of snails, the food being perceived at maximum distances of only 15 to 20 centimeters, and 40 to 50 centimeters in some exceptional cases. The fact that snails are frequently found in kitchen gardens thus seems to be due not to their sense of smell, but to the moisture of the garden. The foregoing results are confirmed by histological investigations, the most sensitive parts of

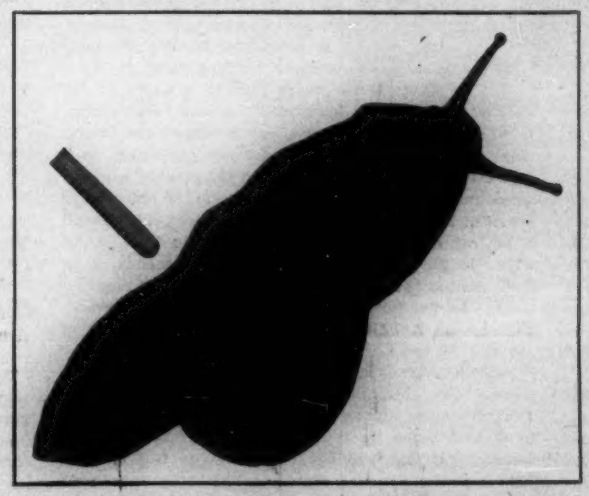


Fig. 2.—Snail Contracting the Edge of Its Foot at 2 Millimeters from a Glass Rod Dipped in Camomile Essence.

THE SENSE OF SMELL IN SNAILS.

the body being found to possess especially large numbers of sensorial cells.

The subdivision and localization of the organs of the senses is thus seen to be rather elementary in the case of snails.

A MACHINE FOR PICKING COTTON.

BY WILLIAM DALE.

Since the invention of the mower, reaper, and binder operated by animal power and steam engines, the idea of utilizing mechanical means for harvesting the American cotton crop has been agitated. The revolution which was caused in agriculture by the modern methods of gathering the cereal crops indicated the saving in time and labor which could be effected in the southern cotton fields if a machine were perfected which would harvest the ripe cotton more expeditiously than the negro farm hand.

A number of devices has been invented to take the place of hand labor in gathering the cotton crop. With one exception, however, all of these have proved failures. The principal defect has been that the machines would harvest the immature as well as mature cotton. Those familiar with this branch of agriculture know that a field must be covered several times after the bolls begin to open, as, unlike grain, the cotton does not ripen with any uniformity. During the last harvesting season, however, a machine was employed in several of the Southern States, which proved to be not only a decided improvement over the ordinary hand method, but by its means only the ripe cotton was picked, the other plants being untouched.

As the photographs show, this picker is notable for the simplicity of its construction. Power is obtained from an ordinary gasoline engine such as is utilized in automobiles of the smaller types. In fact, the engine installed in connection with the picker utilized in the field trials was taken from an Oldsmobile and developed but 8 horse-power. In moving the picker over the ground, gearing is employed as in traction engines. Sprocket chains pass around sprocket wheels on the rear axle, thence upward and around the driving shaft. The engine, which is mounted on the rear of the truck frame, as indicated in the photographs, is employed not only to move the picker over the field but to operate the mechanism by which the cotton is harvested and placed in the storage receptacles. There are four of the latter attached to the sides of the machine. They consist merely of cloth cylinders which are open at the top, the bottom ends being held together by strings so that when the cotton is to be removed it is only necessary to loosen the end by pulling the string, when the contents of the receptacle will fall out.

The lint is conveyed to the receptacles by tubes which are attached to the series of picking devices. The lower portions of these tubes, which are made of thin sheet iron, terminate in steel conduits of the same diameter inside. Each conduit or pipe contains a fan which serves two purposes. It "doffs" or cleans the cotton, blowing out any bits of leaves, casing, or other foreign matter which may have been caught up with the lint by the picker arm, and drives the lint through the tube into the receptacle with which it is connected, by air pressure.

The picker arms are dirigible in design and comprise eight in all, four attached to the forward section of the machine and four to the rear section, all of course being connected with the tubing leading to the cotton receivers and working in connection with fans. The picker arms are fastened to the conduits by means of hinged joints, and as the illustrations show, each consists of a case inclosing an endless belt which revolves upon pulleys placed at either end. This belt is provided with a series of curved teeth. At its outer end the upper part of the casing is cut away, so that the belt is exposed for several inches. When the cotton is to

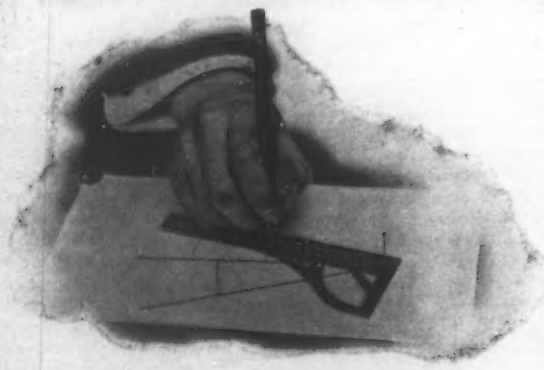
Part of the Field Picked and Unripe Bolls Left on the Plants.

The Cotton-Picking Machine at Work.

A MACHINE FOR PICKING COTTON.

be removed from a boll the operator directs the outer end of the picking arm in such a position that the teeth engage the lint. As fast as it is stripped from the boll it is carried by the endless conveyor to the blower casing, as it is called, doffed, and forced through the tube into the receiving bag. The picking head, as it might be called, is provided with a shield intended to prevent hulls, leaves, and twigs from being drawn into the picker, but, as already stated, any small particles of foreign matter are removed by fans.

The means for actuating the picker belts and doffer fan consist of a light shaft running longitudinally of the machine and parallel to the fore and aft extension tubings. This shaft is geared to the engine through the medium of gears and friction clutch, the lever of the clutch being arranged convenient to the driver. This shaft has a constant speed and is independent of the motion of the machine through the field. Power is applied to the picker belt and doffer fan from this shaft through an arrangement of light sprocket wheels and chains, which permit the dirigibility of the picking arms without in the least interfering with their flexibility.



A CONVENIENT DRAFTING INSTRUMENT.

There are seats provided on the machine to carry four operators, and each operator is provided with two picking arms, one for each hand. The arrangements of seats and picking arms is such that when facing in the direction in which the machine is traveling over the field, the two rear operators face to the right, one picking one side of the center row and the other picking one side of the left outside row. Thus all of the center row and one-half of each of the outside rows, in all equal to two rows, are picked.

During the trials which were made in the cotton fields in North Carolina and Alabama, it was found that eight horse-power was ample to give the machine necessary momentum with its force of hands, also to operate the picking and transferring mechanism. The rate of speed in the fields varies of course according to the amount of cotton to be picked. Where a large proportion of the bolls are open the field is covered in less time than where a small quantity of cotton is ready to be gathered, but it is obvious that with devices which can be guided as described, only the mature cotton need be gathered. As the picking belts revolve at the rate of about 350 feet per minute and eight of the pickers are in continuous operation, the capacity of the machine is much greater than where expert negro labor is employed. During the tests in Alabama the machine moved at the rate of 31 feet per minute, picking three rows of plants simultaneously. In a day of ten hours it covered nearly five acres. The operators were young negro boys, constituting all of the manual labor with the exception of the engineer. In this trial the machine harvested 3,000 pounds of cotton in a day at a total cost of $4.75, including fuel and wages. At the usual price paid for cotton picking in this State the expense for harvesting the same quantity would be $15, while the machine covered a given area in one-sixth of the time which would have been required by six expert cotton pickers. In harvesting cotton in North Carolina the same results were obtained.

While the general design of the cotton picker allows three rows of plants to be harvested at one time, it can be readily enlarged to take in four or possibly five rows, and it is probable that with other improvements its capacity can be greatly increased, just as the harvester and binder of the wheat field has been radically changed since it was first introduced on the farms of the West. The inventor of the cotton picker, Mr. George A. Lowry, is now experimenting with several additional devices which are intended to further increase its speed and efficiency.

A CONVENIENT DRAFTING INSTRUMENT.

In the accompanying engraving we illustrate a very handy little drafting instrument, which may be readily used as a scale, a rule, a square, a curve, a protractor, and a compass. The form of the instrument, as clearly shown in the illustration, comprises two arms forming a right angle with each other and thus providing a square. The longer arm is graduated to sixteenths of an inch, while the shorter arm is provided with a three-quarter scale. Connecting the two arms is a web with its inner edge curved to the arc of a circle whose center is at the point where the two arms meet. The outer edge of the web forms an irregular curve, which the draftsman will find convenient for various purposes. The face of the web is graduated to the degrees of a circle, thus providing a ready protractor. When the instrument is used as a compass, it is arranged to turn on a pin as a pivot. This pin is held in a notch in the instrument by means of a small leaf spring. It will be observed that the longer arm of the instrument is pierced by a series of holes one-eighth inch apart. These serve to accommodate the point of a pencil when drawing the arc or circle. A series of notches are provided for the pivot pin. These are one thirty-second of an inch apart, so that if it is desired to draw an arc whose length is measured in odd thirty-seconds of an inch, the pin is shifted back or forward to the required notch. Larger holes are provided adjacent to the pencil holes, so that the paper can be seen immediately in advance of the pencil point. Circles can be readily drawn without the bother of adjusting a pair of compasses. The convenience of this instrument for work away from the regular drawing table will be apparent to all draftsmen, as it does away with the inconvenience of carrying around a lot of bulky instruments. This improved drafting instrument is being introduced by the Ready Manufacturing Company, of Rochester, New York.

A NOVEL TOY.

A very amusing toy for children is provided by the recent invention of Mr. H. E. Coates, of 820 K Street, Sacramento, Cal. The toy is in the form of an apparently docile mule which, nevertheless, is very balky, and will buck and kick in the most lifelike manner whenever any effort is made to make it move along. The toy beast is mounted on a wheeled base, the wheels being preferably toothed, in order to hold the base in position during the bucking performance. The fore-legs of the animal are rigidly secured to the base, and on the fore-legs the body is fulcrumed so that it can be swung into the position illustrated in our engraving. The eyes of the mule are painted on a pair of slides, and the latter are connected with the ears. A cord runs from these slides under a staple in the base to a lever near the fore-feet of the animal. Another cord connected to this lever passes around a catch at the side of the base, and leads to the operator. When the cord is jerked slightly, the mule throws back his ears and shows the whites of his eyes. A stronger pull makes him lift his hind-legs and kick. The hind-legs and tail are connected by cords to the fore-legs, so that they assume a very lifelike position when the mule kicks. To add to the amusement, a toy rider is mounted on the animal, and it is part of the game to make the beast buck so violently as to throw his rider. Vicious as the beast may seem, he can be quickly pacified by slipping the cord off the catch at the side of the base, and then when the cord is drawn, the lever will swing forward against the staple, and the mule will meekly submit to be drawn anywhere around the room.

A NOVEL TOY.

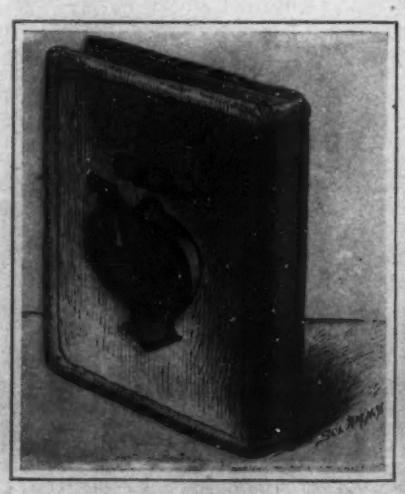
RETAINING DEVICE FOR BARRELS.

A patent has recently been granted to Mr. F. C. dos Passos, Augusta, Ga., on a device adapted to be placed in barrels to retain and compress goods in brine. The device is exceedingly simple, and is designed to take the place of the unsightly weight commonly employed for this purpose. As shown in the accompanying engraving, it comprises a cover, which is placed in the barrel and held in contact with the articles in the brine by a screw. The latter is threaded through a bar, which is held in place in the barrel by means of springs projecting from the opposite ends. The bar is of a concavo-convex form, and the springs secured thereto are cut with double points. The device is placed in the barrel with the concave side uppermost, and the spring points engaging the side walls of the barrel serve to fix the bar against upward movement, and thus provide a good bearing for the screw. Access to the fish, pickles, or the like, below the cover, can be had by unscrewing this screw and tipping up the cover. The bar can be readily pressed down into the barrel, as required. The screw is so adjusted that the bar lies wholly above the liquid, so as to prevent corrosion of the spring points. The only parts that are liable to come in contact with the brine are the cover and the screw, which is preferably made of wood. When it is desired to disengage the bar, it may be inverted by swinging it laterally, when it can be readily drawn out. The spring points may also be adjustably attached to the bar, so that when they are loosened the bar may be removed without being inverted.

RETAINING DEVICE FOR BARRELS.

BOOK PURSE.

A very novel idea is presented in the accompanying engraving which shows a hymnal, prayer-book, or religious manual, fitted with a purse in which money for the contribution can be carried. The purse is large enough to hold a number of coins without increasing the bulk of the book, or detracting from its appearance. In the cover of the book a pocket is formed, and this is covered by a flap mounted on the cover of the book. Folding side pieces connect the flap with the book cover, to prevent the money from falling out when the purse is opened. The purse is closed by a tongue at the upper end, which is slipped under a loop or strap, secured to the book cover. The tongue may be withdrawn from the loop by pulling on an ear connected with the flap. The upper end of the pocket is provided with a recess, to permit of slipping the finger into the purse and under the coin. The purse does not detract from the appearance of the book, but on the contrary the flap is artistically designed and serves as an ornament. The device will prove of great value to ladies, who have heretofore been obliged to carry their contributions in their gloves, with the danger of losing the money and the inconvenience of getting at it when it is wanted. The book purse is the invention of Miss Emma L. Sweet, of Wallace, Idaho.



A BOOK PURSE.

factorily, has given the fundamental principles of steam turbine design in their logical order. Foremost among these is the velocity of steam flow under given conditions. Many of the laws have been developed into simple and direct expressions and are coupled with numerical and graphical solutions illustrating the principles involved.

INDEX OF INVENTIONS

For which Letters Patent of the United States were issued for the Week Ending April 24, 1906.

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Alcoholic liquors, receptacle for storing, S. Schwayder 818,478
Areameter, E. V. Beals 818,601
Automobile steering device, C. F. Jenkins 818,967
Baling press, M. C. Nixon 818,779
Bandages, machine for forming sacks for suspensory, J. K. Toles 818,583
Barrel draining device, L. T. Tucker 818,491
Basement and like ventilator, P. H. Jackson 818,889
Bath tub head support or bolster, C. Rossdam 818,854
Bathtub apparatus, H. Hoeglauer 818,887
Bearing, ball, E. Blin 818,734
Bearing, roller, G. D. Scheiffler 818,919
Bed, folding, W. L. Caldwell 818,517
Bed, musical, J. C. Deegan 818,874
Belt sander, double, D. T. Clemons 818,518
Belt shifter, S. R. Bailey 818,554, 818,931
Bending machine, P. H. Murphy 818,702
Bicycle track, S. W. Tonry 818,488
Billiard cue, J. W. Wilson 818,597
Binder, loose leaf, H. B. Burckhart 818,604
Binder, temporary, L. C. McNeal 818,548
Binding post, C. Slusser 818,490
Bit. See Bridle bit.
Blind adjuster, I. L. Garside 818,758
Boat holding down and attaching device, McHorney & Kelley 819,022
Boiler attachment, J. Moffat 818,480
Boiler or blow-off connection, steam, Mueller & White 818,775
Boiler brace, L. G. Mong 819,020
Book support clamp, F. E. Ruger 818,917
Bookbinder, D. McCann 818,777
Boring machine, A. J. Turner 818,820
Bottle, Harrins & Hogan 818,823
Bottle, F. E. Allen 818,506
Bottle and jar cap, A. Calleson 818,741
Bottle closure, E. Taylor 818,798
Bottle closure branding machine, O. H. Jung 818,896
Bottle lock, J. Solatinow 818,984
Bottle neck shaping tool, C. House 818,691
Bottles, jars, and other receptacles, safety closure for, J. V. Hull 819,015
Boxing purposes, presser machine for, G. N. Pond 818,845
Brake, W. G. Price 818,639
Branding tool, M. P. Sullivan 818,482
Brick mold, J. A. Judle 818,452
Bridle bit, G. M. Peters 818,781
Brooder, L. W. Clark 818,873
Broom rake, N. Dort 818,751
Brush, W. E. Whittemore 818,497
Brush, O. Fish 818,531
Brush, R. Kulenkampff 818,696
Brush, fountain, Caddell & Sutherland 818,605
Bucket, dumping, C. J. Close 818,868
Bucket operating mechanism, clam shell, F. E. Hulett 818,626
Buckle, W. F. Osborne 818,780
Buckle, line and rein, F. M. Kibbey 818,970
Buckle, trace, O. Rampendahl 818,559
Buckle, trace, E. L. Goodrich 818,881
Buggy bow spring attachment, G. A. Johnson 818,827
Building block, N. J. Peterson 818,561
Burial caskets, coffins, and the like, handle for, C. Bleach 818,733
Butter cutter, C. F. Fogg 818,757
Butter cutting machine, B. J. Lehman 818,770
Button, E. A. Smith 818,983
Button, collar and cuff, J. R. & J. G. D. Thoma 818,486
Cable grip, aerial tramway, E. P. Frederick, 818,806, 818,805
Calendar, perpetual, W. B. Summerall 818,577
Camera attachment, W. E. Phillips 818,553
Can beading machine, Adriance & Calleson, 818,805, 818,805
Cane loading apparatus, L. J. B. Trouard 818,644
Cannon recoil mechanism, F. B. Yingling 818,730
Car brake, motor, R. Rugge 818,815
Car, brick, F. H. Reid 818,851, 818,852
Car coupling, A. Schulz 818,564
Car guard rail, street, P. Dandridge 818,501
Car journal box, railway, J. R. Williamson 818,501
Car lever, G. B. Sullivan 818,576
Car, railway, H. L. Kerr 818,629
Car register, F. A. Schierberg 818,563
Car, sleeping, P. P. Carroll 818,742
Car wheel, A. Mast 818,900
Carburetor, L. Renault 818,853
Carpenter's tool, Hause & Martin 818,958
Carpet sweeper, W. H. Emmert 818,755
Carriage, folding baby, A. B. Todd 818,487
Cart, road, E. P. Hollister 818,963
Case. See Display case.
Caster, O. Hoffmann 818,442
Casting machine, E. E. Weise 818,927
Casting mold, J. M. Dodge 818,941
Cattle guard, F. V. Grimes 818,883
Chain, detachable drive, L. R. Rogers 818,469
Channeling machine, W. Prellwitz 818,558
Charging or feeding device, W. H. Blauvelt 818,862
Check back attachment and clamp for teams, T. Schmeiser 818,792
Cheese cutter, R. D. Drummond 818,526
Chuck, drill, G. R. Rich 819,025
Chuck, rock drill, Harris & Hoskin 818,687
Churn, Z. L. Harbin 818,537
Chute, adjustable stock, A. B. Starrett 818,571
Cider mill, E. R. Goings 818,683
Cigar bands or labels, book, dairy, album, etc., for the preservation of, J. Hill 818,961
Cigar bunches, device for the preliminary forming of, G. J. Prentice 818,786
Clamp bracket, E. A. Litts 818,457
Clipper, hair, T. W. McNally 818,462
Cloth pressing machine, J. Ecker 818,733
Clothes pin, C. W. Boese 818,658
Clutch, R. S. Kneeon 818,528
Coal cutting machine, A. H. Gibson 818,619
Coal finding instrument, L. B. Mognett 818,902
Coke ovens, drawing machine for, R. D. Martin 818,841
Collar and cuff shaper, G. L. Richardson 818,915
Collar, horse, G. W. Hahn 818,621
Collar stay, L. C. Collins 818,517
Color applying apparatus, pneumatic, F. Wolf 818,640
Combing machine, gill box, etc., wool, Ormondroyd & White 818,707
Combination lock, D. H. Cleveland 818,414
Commodes, W. C. Poely 818,821
Concrete dam, laminated multiple arch, S. P. Brown 818,736
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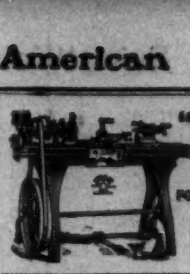
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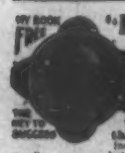

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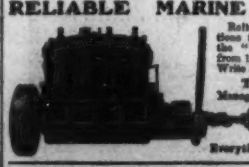

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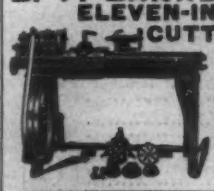

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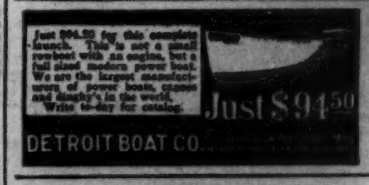
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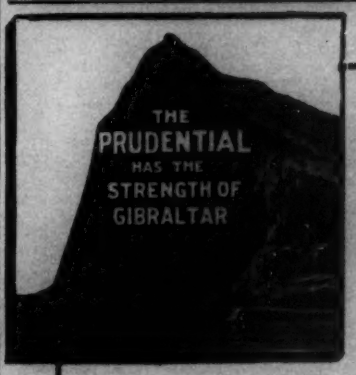

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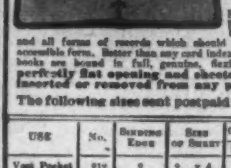

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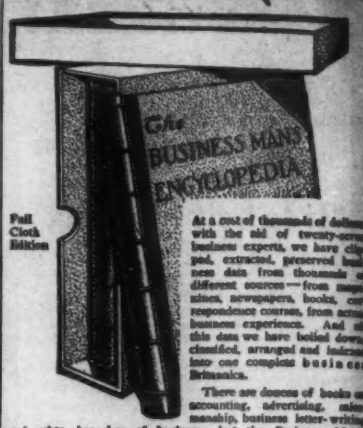

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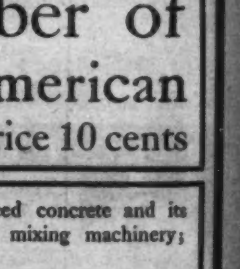

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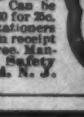

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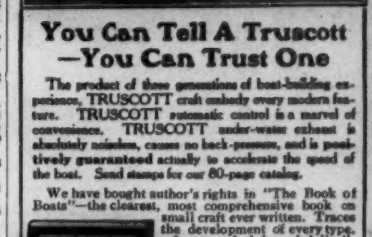

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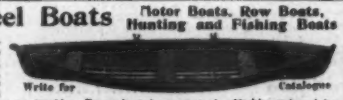

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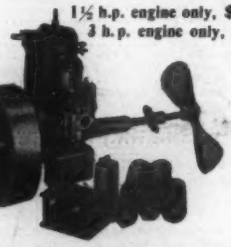

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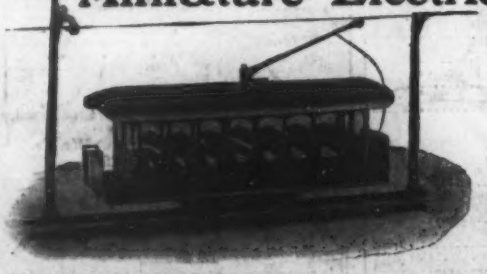

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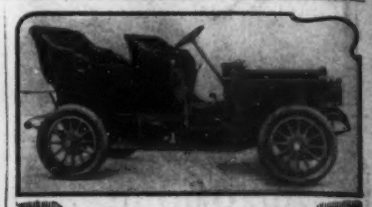

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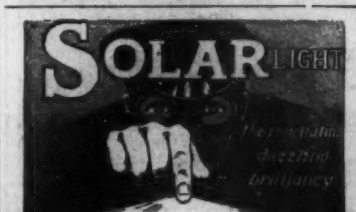

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